THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXIX. No. 5.

AUGUST, 1922.

NOTES FOR THE MONTH.

Honorary Degrees for Agriculturists.

THE ceremony of the conferring of honorary degrees at Cambridge is always interesting. The historic Senate House, the dignity of the proceedings, and the unfamiliar tongue in which they are conducted, the black or scarlet gowns of the University potentates culminating in the black and gold of the "most illustrious Chancellor," above all the eminence of the men who are there to receive honour from a great man, the chosen head and representative of a great University—all these combine to impress the most casual visitor.

But this year everyone who is concerned with agriculture must have felt a special interest in the proceedings; for six out of the nine who received honorary degrees on the 6th July, were men whose names are known throughout this country and beyond it because of their services to that great industry. They were Mr. C. R. W. Adeane, Sir Gilbert Greenall, Sir Daniel Hall, Mr. E. S. Beaven, Mr. A. E. Humphries and Mr. Ernest Mathews.

It is the practice for the Public Orator of the University in presenting to the Chancellor (at present the Earl of Balfour) each recipient of an honorary degree, to make a short speech describing the activities, virtues and services of the candidate —whose blushes are spared (unless he happens to retain a good share of youthful acquirements) because the speech is involved in the decent obscurity of a dead language. In the present case some account of these brief biographies may be interesting to readers of the *Journal*.

Mr. C. R. W. Adeane, the Public Orator said, is familiar to Cambridgeshire, of which he is Lord Lieutenant: he is

(44130). P.1./R.3. 10,750. 8/22. M. & S.

known far outside the county as a famous breeder of pedigree sheep and shorthorns (" cows adorned with a somewhat short horn "). A visit to the Royal Show will prove his skill and industry. The Royal Agricultural Society can testify to his financial powers.

Sir Gilbert Greenall was described as one who had learned his philosophy from life itself; a union of farmer and sportsman, the greatest judge of horses and cattle in England. He has found the way to combine fertility and amenity on his estates; and, finally, he is known as the autocrat of the Royal Agricultural Society's Show, to whose sway all bow.

Of Sir Daniel Hall the Public Orator first spoke as one of the Development Commissioners, to whom 13 years ago the Chancellor of the Exchequer entrusted the spending of " immense sums " for the benefit of agriculture. He administers all agricultural research whether in the field or in the laboratory. He has an unequalled knowledge of the past history and present uses of the countryside, its roads, villages and various districts. If you seek a proof, read the book which " this second Cobbett " has written on his pilgrimage through Britain. He is an eloquent speaker, a great gardener and lover of tulips, besides a keen collector of Japanese prints and Chinese pottery.

Mr. E. S. Beaven appeared in the Public Orator's speech as the apostle of self-reliance. He has produced and made known to this country two new kinds of barley. He is a king among barley cultivators, farmers, and professors alike. Whatever his hand finds to do, he does it with all his might, whether it be the sowing of barley or the driving of a motor-car.

The services of Mr. A. E. Humphries and his association with Professor Biffen in the improvement of wheat formed the main subject of the Public Orator's speech in presenting him to the Chancellor. Mr. Humphries has proved that Canadian wheat can be grown in this country, and if mixed with our own wheat, improves the quality of the bread. He has investigated the construction of mills, and devised improvements of machinery: he is a firm believer in the power of science to promote human progress.

Mr. Ernest Mathews was presented as equalling the Latin poet in his love of cattle, and far surpassing him in knowledge. " He has taught us the value of a certain kind of island cow." He claims as his province everything which comes from milk. He is an investigator and inventor in all the arts of separating

cream, of butter making and of cheese making. There is another art dear to the shepherds and cowherds of Virgil which he has not neglected, for he is a great lover of music.

Even these brief extracts from the Public Orator's remarks will convince our readers that the recipients of Honorary Degrees are to be congratulated not only on the honour done to them but on the felicitous eulogies with which that honour was accompanied. All agriculturists will join in these congratulations, and recognize the justice of the eulogies.

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Importation of Canadian Store Cattle.

THE long anticipated debate in the House of Commons on the subject of the exclusion of Canadian store cattle under the Act of 1896 took place on 24th July, the decision being left to the free vote of the House without any official intervention on the part of the Government. The question was raised on the following motion put down by Mr. Shaw :—

> "That this House is of the opinion that the time has arrived when the embargo on the importation of Canadian cattle should be removed,"

and a considerable number of Members of all parties spoke both for and against the motion.

The Minister of Agriculture, Sir Arthur G. Boscawen, spoke strongly in favour of the retention of the Act of 1896. The voting was ultimately, however, in support of the motion, which was carried by 247 votes to 171, a majority of 76.

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Harvest Weather Forecasts.

THE Meteorological Office will supply farmers with the following two classes of weather forecasts which are of special value at harvest time :—

Regular Forecasts.—These are for the farmer who wants to keep an eye on the weather more or less every day. He can get them telegraphed in the early morning, in the middle of the day, or about tea-time. They cover the next 24 hours. *No charge* to registered recipients (Registration fee 1s.) except the Post Office charge for telegraphy.

Spells of Settled Weather.—Whenever a few days' settled weather is seen approaching a message is sent out informing

subscribers of the fact. A small charge of 6d. per message is made in this case in addition to the cost of the telegram.

Fuller particulars will be supplied on application, but forecasts will commence on receipt of a note addressed to the Director of the Meteorological Office, and a sum either in the form of a deposit of 7s. 6d. or sufficient to cover the total cost of the messages asked for.

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Conciliation Committees in Agriculture.

THE total number of agreements in operation at the present time is 45, which is the largest number at any one time since the Committees were set up.

The Committee for Carnarvonshire has reached an agreement covering the hiring period up to 13th November for a rate for adult special class workers of 21s. per week (of 61 hours up to 30th September and of 58 hours for the remainder of the period) plus the provision of board and lodging (estimated in the case of such workers as being equivalent to 12s. 6d. per week), and of 32s. per week (of 52 hours) for other adult male workers. The Derbyshire Committee has decided to extend its agreement, which was due to expire in June, up to the end of September, the rates for adult male workers being 7½d. per hour for weekday employment and 10d. per hour on Sundays.

Several Committees have had under consideration the question of harvest rates, and agreements have already been reached in the East Riding of Yorkshire, in Anglesey and in Essex, and agreements in other areas where this question is of importance are anticipated shortly. The East Riding Committee has agreed that for haytime overtime shall be paid at the rate of 1s. per hour for all time worked over the normal hours in actual operation on individual farms. This Committee has further agreed that the minimum rate of harvest wages for weekly workers (exclusive of horse lads who are not in receipt of overtime pay for attending horses) shall be a fixed rate of £3 per week for a harvest of 4 weeks, the hours to extend to 7 p.m. during cutting and 8 p.m. when leading, and up to 6 p.m. on Saturdays throughout: after 4 weeks harvesting minimum wages to be at the ordinary rate and ordinary overtime, *i.e.*, time and a quarter. As an alternative the Committee has agreed on the payment of the ordinary rate with overtime at the rate of 1s. 6d. per hour during harvest operations.

The terms of the Anglesey Committee's agreement provide that during the hay and corn harvest, adult male workers shall be paid at not less than 30s. plus board for a week of 56 hours.

Under the agreement of the Essex Committee the harvest wages will be as follows:—

1.—(*a*) 7½d. per hour for 50 hours per week to be paid where possible on a Friday, plus a bonus of £4 10s.; the bonus to be paid on completion of harvest. If part time only is worked in the harvest a proportion of this bonus to be paid. Alternatively (*b*) a rate of 9d. per hour to be paid for all time worked at harvest work where this system is preferred.

2.—These agreements do not prejudice the piece-work system of harvesting so long as the rates paid are not less than the above.

3.—The hours to average 11½ per day, and when possible leaving-off time to be one hour earlier on Saturdays.

4.—In cases where an amicable interpretation of the agreement cannot be arrived at, the matter should be referred to the Conciliation Committee for their consideration.

Particulars of the agreements in any area can be obtained on application to the Ministry.

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The Agricultural Index Number.

THE prices of practically all kinds of agricultural produce are liable to seasonal variations, and this is especially the case with products such as eggs and milk which fall in the spring as larger supplies come on the market, and rise again as the season advances when supplies become more restricted. Wheat is often affected by the large supplies which are put on the market after the crop is harvested, and barley is affected by the larger quantities of malting quality sold in the autumn. In attempting a comparison of the changes from month to month the seasonal variations must be taken into account, and with this object the monthly index numbers given below are based on the average prices of the same products in the same months of the three years 1911-13. The figures show that the average prices of farm products generally during June were 68 per cent. above those ruling in June, 1911-13. By this arrangement seasonal

fluctuations which are more or less normal to the time of year are practically eliminated. Hitherto the monthly index number has been based on the average prices of the three years, 1911-13. The actual difference is not great in practice, but the present system shows the price changes more accurately.

	Percentage Increase as compared with the average prices ruling in the same months of 1911-13.	
	1921.	1922.
January	183	75
February	167	79
March	150	77
April	149	70
May	119	71
June	112	68

The June figures show on the whole a slight reduction from those of May. This is attributable principally to the recent decline in the value of fat sheep and potatoes, both of which reached a very high point in May but have since declined considerably. Other changes during June were comparatively slight.

The changes which have taken place during the past six months are, however, rather striking in the case of several commodities, as will be seen in the following table which is calculated on the same basis as that referred to above :—

	Percentage Increase as compared with the average prices ruling in the same months of 1911-13.					
	Jan.	Feb.	Mar.	Apr.	May	June
Wheat	44	50	66	57	62	60
Barley	51	49	46	49	49	58
Oats	49	48	53	49	53	57
Fat cattle	62	67	66	65	70	71
Fat sheep	60	72	100	128	140	121
Fat pigs	71	82	85	90	91	82
Eggs	114	166	95	89	50	69
Poultry	76	80	77	83	110	116
Milk	125	117	92	42	27	28
Butter	46	41	37	49	54	59
Cheese	27	33	42	46	48	55
Potatoes	113	122	112	95	140	80
Hay	35	32	32	28	33	35

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THE FUTURE OF BRITISH AGRICULTURE.*

The Right Hon. Lord ERNLE, P.C., M.V.O.

I HAVE never before addressed an audience of agricultural students. I find myself in this difficulty. I fear that what I am going to say may be to you as elementary as A B C. The unknown is always a bogey. I am ignorant, and, therefore, in awe, of the extent of your knowledge.

Your President has asked me to forecast "the Future of British Agriculture." Prophecy is easy. It is also dangerous. Fortunately for me, I am not a pessimist, and it is only the prophets of evil who catch the public eye. I can, of course, give you nothing but my personal opinions on a subject in which no certainty is attainable. The course of agriculture cannot be predicted with accuracy. It depends largely on fluctuating world-conditions. Even if it could be forecast in this country, the influence which the play of urban interests and party politics may exercise on its direction is incalculable.

I think that the future of British agriculture is bound up in arable farming—not for corn-production only, but for the combined production of bread, meat and milk. I think so for three main reasons. Firstly, it is tillage alone that can satisfy the demands of the community. Secondly, it is in the direction of tillage that science seems to be moving all along the line, and tillage can make the fullest use, over the widest range, of scientific developments. Thirdly, tillage, for the combined production of bread, meat and milk, unites in a common enterprise the two great branches of the industry, for the increase and improvement of our live stock become vital to the interests of arable farmers.

I shall not discuss the economic factors of the problem. They lie off the line of my inquiry, and they have been admirably treated in Mr. Orwin's Presidential Address before the Agricultural Section of the British Institution. But I realise that they strike at the root of the matter. How to combine the maximum of efficiency with the minimum of cost—how to attain the desired ends of increased production with the least possible expenditure of means—are matters of extreme urgency and importance. Economic difficulties hamper the maintenance and extension of arable farming. They block the

* An address to the Plough Club at Oxford.

way to the adoption of proved methods of increasing the output from the land. They affect the whole range of the farmer's business. I might insist, for instance, on the value of milk-records as the only test whether a cow is paying her way, or of co-operation in buying, selling and distribution. Or I might preach the advantages of establishing, on a commercial basis, those rural industries, by which, during the dead season on the land, agricultural workers might earn an adequate livelihood. Or I might urge the boon which would be conferred on agriculture, if a standard of economic efficiency in organization were formulated, and adapted to varying units of land or local conditions, so as to supply a test by which each individual farmer might check the economic efficiency of his own management. Or I might dwell on the need for supplying agricultural credit, and suggest the trial of one or other of the various continental methods. But, on this head, let me remind you that our system of landlord and tenant is, in effect, a practical means of supplying credit facilities. When a tenant takes a fully equipped farm, he virtually receives a substantial loan at the very moderate rate of interest which is represented by the rent.

Though I do not discuss the economic factors in the problem, I cannot get away from them. They crop up everywhere. They will not take "no" for an answer. They are specially important in regard to my first point. I shall steer as clear as possible of politics. But obviously, this reason for thinking that the future of British agriculture lies in tillage, namely, that tillage alone will satisfy the demands of the community, raises a number of social, political and economic questions.

The use to which agricultural land is put is no longer the private concern of owners and occupiers. It has become a matter in which the nation is vitally interested. This principle has, I believe, come not only to stay, but to exercise a growing influence. The needs of the community will have to be seriously considered. On the kind and quantity of the produce which is raised from the soil, and on the amount and remuneration of the labour that is employed, the nation will make its voice increasingly heard. Unfortunately, there is, at the present moment, for economic reasons, a sharp antagonism between the interests of the nation and of farmers. While the nation is intent on increased production, the farmer is cudgelling his brains how to make arable farming pay, and secure some return on his capital.

This economic antagonism cuts across agricultural operations at many points. A simple illustration is that of spring dressings of artificials on the wheat crops. Three of these dressings will considerably increase the yield of grain and of straw. It is, therefore, the national interest that all three should be applied. But the farmer has to consider the expense of the dressings in relation to the price of his produce. He has to decide whether they will cost more than the added yield is worth, whether he will give none, or stop after the first or the second. He acts accordingly. The nation asks for the maximum output; the farmer cannot produce more than he can afford.

But the most important example of this divergence of interests is afforded by the conversion of arable land to grass. When a farmer lays down his tillage to pasture, he relieves himself from many anxieties. He lessens his pecuniary risks. He makes himself more secure of a modest return on his capital. He has not to work so hard or continuously. He produces the two commodities—fresh meat and milk—which are least exposed to foreign competition. Above all, he reduces his *total* labour bill per 100 acres, a more important matter to him than individual rates of wages, by something between a half and two-thirds. As a man of business, he is prudent; as a farmer he is adapting himself to existing conditions. But the nation suffers a two-fold loss. It suffers, firstly, from the reduction of employment and its consequences—rural depopulation, urban congestion, increased competition for employment in towns, a lowered standard of national health and virility. It suffers, secondly, from the reduced output of food. Our grass-lands have been too much neglected: they can be and ought to be improved. Sir Daniel Hall is lyrical on lime; Professor Somerville puts his last shirt on basic slag. They are both right. Mine is a different point. Suppose you could eliminate from our poor pastures all the rush and bent and birds-foot trefoil. Suppose you could replace them with plenty of clover, rye-grass and dogstail. Suppose you could raise the quality of your Poverty Bottoms to that of those rare parcels of pasture which are justly classed as rich. Even then, you would be unable to raise half the quantity of food, measured in meat and milk, which could be produced from the same acreage of average arable land. In 1870, agriculture fed with home-grown food something like a third more people and employed a third more labour, than it did in 1918. Why is its

power to support or employ a portion of the population reduced? In the main, it is because we have had to turn from arable farming to grass farming. I do not believe that the paramount urban interests would tolerate, for any length of time, an agricultural system which, on any extended scale, sought salvation in the conversion of tillage to grass, and the consequent reduction in output of food and employment.

The farmer's answer is simple. He says that, as a matter of business, arable farming cannot be made to pay; cheapness of food is incompatible with large production. A serious question arises. Will the ill-informed opinion of the towns have patience to wait, while inquirers in every branch of science collaborate with practical farmers to make tillage a business proposition, that is to say, to make it show profits? I think it will. The mass of the community are aware that, whatever changes are introduced, the economic problem of making tillage pay remains to be solved. If they see that a real, practical, combined effort is being made in this direction, they will give the requisite time. But the effort must be made.

Economic science will deal with the reduction of expenses to the minimum consistent with efficiency. To other branches of scientific inquiry we look for those increased yields from the soil, without a proportionate increase in the cost of production, which will give a margin of profit. So I reach my second reason for my faith in arable farming, namely, that tillage is the direction in which science seems to be moving all along the line, and that tillage is the branch of the agricultural industry which can benefit to the fullest extent, and over the widest field, by scientific developments.

Even with our present scientific resources, the prospect is encouraging. Over the whole range of plant-production on the farm there exist the widest differences between the exceptional and the average yields. In potatoes, for instance, the decennial average yield is not much over 6 tons to the acre. I do not know the highest recorded yield. But in 1918, on freshly broken pasture-land, 18 tons were raised to the acre. Or take mangolds. The average yield per acre is 19¼ tons. On an acre of newly broken pasture in 1918, 47 tons were grown. Or take the three cereals, wheat, barley and oats. The average yield of wheat is 31 bushels to the acre; the highest recorded yield is 97 bushels. Of barley the average yield is 32 bushels, and the highest recorded yield is 80 bushels. Of oats the average yield is 40 bushels, and the highest recorded yield is

121 bushels. The decennial average, of course, represents good and bad farmers, good and bad land, good and bad seasons. Between the highest record and the average come the actual normal achievements of good farmers. They not only grumble, but are really disappointed, if they do not exceed 40 bushels of wheat or barley, and 50 to 60 bushels of oats. It is not impossible to raise the general average towards the actual achievements of good farmers, and, with the aid of science, to approximate to the record. If money is lost or balanced on the average yield, it would almost certainly be made on either of the higher yields.

To what causes are the differences between these three yields to be attributed? To the human agency, to favourable climatic and soil conditions, to the use of the best and most prolific varieties of seed, and to the adequate nutrition of the plant. We must not underrate the importance of the human agency. The personal equation counts for much. Good farmers are not in the majority. We want more men of energy, capacity, enterprise and education, men who will build up their practical experience on the foundation of a scientific training. We hope to get men of this stamp from Oxford and Cambridge. Capital is, of course, a necessity; the industry is often, for want of it, starved. Its provision is one of the economic problems.

There remain the natural limitations of climate and soil, the use of the best and most prolific seeds, and the adequate nutrition of plant life. It is here that science has helped, is helping, and will help still more.

Climatic conditions, especially rainfall, cannot be controlled by human agencies. It is this fact which mainly distinguishes agriculture from other industries. Farmers are at the mercy of the weather. They must adapt themselves to local conditions, humour their climate, grow the crops which it favours, avoid those which it resents. Speaking broadly, this is the only safe rule. On this principle the farming of this country is differentiated. The wet climate of the West favours leaf-production; the drier climate of the East favours grain production. But to some slight extent, climatic conditions can be modified. They can be modified by drainage, or to a less degree by the right use of artificial fertilisers. Thus phosphates help to mitigate the disadvantages of cold and wet, while, if the climate is too dry, potassic fertilisers promote the continued growth of the plants. To some extent, also, mechanical science helps farmers to steal a march on the weather. The preparation of a seed bed, com-

pact enough to keep the seed in contact with the soil, yet sufficiently broken to enable the infant roots to travel in pursuit of food, is obviously dependent on weather. So, also, is the right moment for sowing, on which hangs so much of the success of the crop. Few days in the winter months are favourable for either operation, and protracted harvests necessarily drive farmers into a corner. To be well forward with the autumn cultivations is an immense advantage. It gives the farmer the benefit of weathering his land by a partial fallow; it widens his choice of the best opportunity of getting in his seed. Time is of the essence and it is often lacking. It is here that mechanical science has already given valuable help. Tractors may not be cheaper than horse-ploughs. With the present prices of fuel and repairs they may be at least as costly. But they are as effectual, and far speedier in their working. They are also still in their infancy. Improvements in their mechanism may be confidently expected, as well as the application of their principle to other agricultural operations. Every step in these directions means greater control over the natural limitation of climate.

Another natural limitation is the character of the soil. Heavy land is favourable to leaf production, land of lighter texture to grain production. But soil conditions are much more amenable to human control than climatic conditions. Drainage, for instance, is a powerful controlling agent, by no means adequately employed. The natural limitations may, also, be profoundly modified by cultivation. In this direction great advances may be expected. The results of cultivation leap to the eye; but the precise nature of the effects produced are not yet scientifically ascertained. Cultivation is still rather an art than a science. Knowledge is control. Progress has already been made in the study of the physics of the soil. We stand on the threshold of great discoveries. We know that the soil is not a dead mass of mineral particles. It is teeming with life. In the multitudinous struggle for existence which goes on beneath the surface, each living organism influences the changes which affect the growth of plants. Science is making a determined effort to master this subterranean chemical laboratory and to direct its operations. If it succeeds—and it will—the effects may be far reaching.

Let me give you one simple illustration. Clover is already one of the most valuable of our crops. It is so not merely because of the fodder that it supplies to cattle. It is so, also, because of its peculiar power of enriching the soil with nitrogenous

matter. Possibly science may be able to stimulate still further the action of the nodules at the roots in which this fertilising power resides. But the potential value of the crop is as yet limited by two of its characteristics. It cannot be grown continuously on the same land, and it is liable to more or less frequent failures, though these may, of course, be mitigated by an admixture of grass. If the study of the biology of the soil solves the mystery of the failure and enables farmers to grow the crop continuously on the same land, the full potentialities of clover will be utilised to immense advantage.

Further control over the natural limitations of soil conditions, as well as the proper nourishment of plant life, are gained by the command and right use of farm-yard manure and of artificial fertilisers.

As the best of our all-round manures, "muck" is the basis of the manuring system of the farm. Something between 35 and 40 millions of tons of farm-yard manure are produced annually in this country. It is probably no exaggeration to say that at least half is wasted from improper making and storage. Its management is a first-class test of a first-class farmer. Whether science will some day invent a method of fixing which will prevent the leakage of the precious urine may be doubted. The clamp, properly placed and made, at present holds the field as the best preventive of waste. Again, the bacteriological process of rotting straw may be valuable where there is an excess of straw. Its cost works out, I believe, at something like 5s. per ton. But, for myself, before buying the plant I should be inclined to try a larger head of stock. Under the modern hygiene of the dairy, there is a danger that the manure of dairy cattle may be wasted. To avoid contamination of the milk, bedding can only be used sparingly and the stalls must be cleaned out at least once a day. It is a matter which has not escaped the attention of science, and a remedy will, I believe, be found.

Large as is the supply of farm-yard manure, it remains inadequate. In this respect agricultural chemistry has supplemented the resources of farmers. But artificial fertilisers are more than a supplement. Their best results are generally obtainable in combination with farm-yard manure. Few persons suppose that chemistry has shot its bolt, and that no new combinations or ingredients may be discovered. In the intelligent use of the substances already known much remains to be done. Many men still do themselves as much harm as

good by the choice of the wrong fertilisers. In the saving of the most valuable properties of farm-yard manure, in greater knowledge of the use of existing fertilising agencies, and in the future discoveries of agricultural chemistry lie great potentialities of increased yields without a proportionate increase in the cost of production. Not the least of the advantages of improved machinery and implements and of the greater command of fertilising agencies, is the freedom which they confer on farmers from the too rigid tyranny of rotations and the necessity of fallows. Weeds can be rapidly eradicated by the one, and fertility maintained by the other, with the result that the same crops can be grown continuously on the same land.

Increased control over climate by the use of improved machinery, increased control of soil conditions as the result of the study of the physics of the soil, increased control of the foods appropriate to plant nutrition are important steps in raising average yields towards the highest recorded yields. Another step is the increased command and use of the most prolific varieties of seeds. Plant-breeding is the fairy-land of agricultural science. No limit can be set to the possibilities in store, especially with the aid of a deeper knowledge of the physics of the soil. One example may illustrate the value of this collaboration. A very serious difficulty in introducing the most prolific varieties is the weakness of the stem. The strength of the straw is only in part dependent on the plant itself. Another part depends on soil conditions. Solve that mystery and the plant breeder will do the rest. Nor must the work of the plant pathologist be forgotten in the cure or prevention of plant diseases from a variety of causes. The annual loss from these pests is very large. I cannot vouch for the figure, but I have heard it estimated at 27 million pounds a year. It may bring home to us the magnitude of this sum, if we remember that it is, approximately, the net annual cash value to the farmer of his sales of the wheat and potato crops of the United Kingdom.

I have touched on a few of the ways in which science is helping to make arable farming a business proposition. I do not say that science has nothing to offer grass-farmers. It has much. But I have, I hope, shown that it is tillage which can profit most and over the widest range by scientific developments. You may, however, quite rightly remind me of the natural limitations imposed by climate and soil. You may ask, with reason, do not rainfall and heavy land restrict arable

farming to the dry climate and the soils of lighter texture. I do not think so. So I reach my third and last reason for my faith in tillage. Neither a moist climate nor a heavy soil restrict farmers to grass. There are arable crops which are equally adapted to these natural conditions, equally suited for the summer production of meat and milk, superior to pasture in supply of winter food, and yielding a much greater weight of fodder all the year round. Such are seeds, mangolds, vetches, peas, kale, rape and combinations of crops like oats and tares, or oats and peas, or rye and vetches. Some can be fed direct in winter; some can be turned into hay or ensilage for winter use; others can be fed green in the summer. Such a system lends itself to great extension and development. It reduces to a minimum the ration of roots, which, on the decennial average of a yield of under 14 tons to the acre, are absolutely ruinous to produce. It makes it possible to carry on three acres, two cows instead of one, maintain them in good health, and obtain an increased yield of milk. Keep your eyes open for the Reports of the Harper Adams College, and study the system wherever you find it even partially adopted.

Meanwhile, let me point out the features in which the system satisfies some of the requirements of which I have been speaking. It satisfies the demands of the community, for it produces per acre more food and employs more labour than grass. It profits by all the aid that science can render in the directions which we have traversed. It enables a heavier head of stock to be carried, whether for the dairy or the butcher, than can be carried on grass, and thus unites the corn-growing and live-stock industries in one common enterprise. It can utilise all that science may have to teach on the improvement of live stock for the various purposes for which they are bred, on their most economic yet efficient feeding, on their protection or cure from disease. It will give farmers command of more manure, and of richer manure, because it will be derived, not only from young growing animals, but from dairy cattle and, still more, from fatting beasts. It sets in motion the familiar round of the more fodder, the more stock; the more stock, the more manure; the more manure, the more fodder crops.

These are the main reasons why I think that the future of British agriculture is bound up, sooner or later, and, in my belief, sooner rather than later, in arable farming.

May I close on a different note? I accepted your President's invitation, because I take a semi-fatherly interest in the success

of your agricultural course and am convinced of its value to the country. Men of education, capacity and initiative are needed in the industry. For you there is a place and a lead, if you will qualify to take the one and give the other. Fortunes may be rarely made in farming. But I know few careers which are fuller of varied interests, few in which you can so long continue to learn, few which are richer in opportunities of service to your fellow men. I wish long life and prosperity to the Oxford Plough Club.

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FARM INSTITUTES.

PART I.

THE increased provision made by the Government for agricultural education since the War has enabled the Ministry to aid the establishment of several Farm Institutes. Farm Institutes are not intended to give the student a thorough training in agricultural science, or to teach him the way to farm. The aim is less ambitious. The time which a young man can spend at a Farm Institute is short—usually only the six "winter" months. During that period the Institute endeavours to give him instruction in the scientific principles underlying the practical experience which he gains on his own farm, and thus to send him back to the farm with a revivified interest in the work that lies before him. In one or two Institutes the course extends throughout the year, thus enabling instruction to be given in the field during the summer months; but normally the summer is devoted to instruction in dairying, etc., for women, when the Institute aims at giving the woman student such training as will render her an efficient partner in the management of a small farm. The farm attached to the Institute is not intended only for the benefit of the students, for their stay at the Institute is at a time when farm operations are reduced to a minimum. It certainly provides material for teaching, and the Farm Institute course is made as practical as possible; but beyond this the farm is the headquarters of the county staff of agricultural lecturers, serving to keep them up-to-date in farm practice. It is also a centre for experiments and demonstrations intended for the benefit of all farmers in the county.

From the brief *résumé* of courses, fees, etc., at the Farm Institutes which is given at pp. 477-80 of this *Journal*, it will be

seen that at the present time there are 12 Schools of this type in England and Wales. Two of them—the Chadacre Agricultural Institute, Suffolk, and the Monmouthshire Agricultural Institution at Usk—have been established through the generosity of private individuals. The others have been set up by County Councils with financial assistance from the Ministry. The main features of the training at four of the Institutions are given below.

EAST ANGLIAN INSTITUTE OF AGRICULTURE, CHELMSFORD.—The work of the Institute commenced in 1893, when the site of an old Grammar School in the centre of Chelmsford was purchased, and part of the old school buildings was fitted up and devoted to the teaching of biology and chemistry. Ten years later the present extensive and admirably equipped Institute, comprising lecture rooms, laboratories, dairy, library, museum, staff and common rooms, etc., was erected. In 1901 three acres of land, about three-quarters of a mile from the Institute, were acquired and converted into a school garden, which was laid out and equipped in such a way as to enable students to acquire a thoroughly practical knowledge of flower, fruit and vegetable gardening. Recently, an additional two acres have been acquired in order to provide facilities for instruction in market gardening.

Courses of Instruction.—*Agriculture.*—The course is designed for those who intend to take up farming or otherwise make their living on the land, and deals with soils, manures, farm crops, live stock, farm machinery, farm book-keeping and land surveying. The economical production of all forms of agricultural produce receives special attention. The session lasts from October to March. On an average 50 students, the majority of whom are farmers' sons, attend this course.

Two demonstration farms have recently been placed at the disposal of the County Agricultural Committee, viz., Bradfield Hall Farm and Layer Breton Hall Farm. The public-spirited action of the owners, Mr. J. Hepburn and Mr. William Hasler, in offering their farms for experimental and demonstration purposes without any charge to the county is warmly to be commended. On Bradfield Hall, a farm of 375 acres, experiments have already been carried out to ascertain the value of subsoiling and shallow sowing of cereals. Layer Breton Hall is a mixed farm of some 400 acres with a soil of

heavy London clay; approximately 270 acres are arable. The farm is equipped with a silo, and cow-shed for 52 cows. The intention is to determine the most suitable system of cropping for heavy land of this type.

Dairying.—Three courses of 12 to 16 weeks are given during the year. The dairy is fully equipped with modern apparatus and deals with upwards of 20,000 gallons of milk annually. The students, who are mainly the sons and daughters of farmers and smallholders, receive instruction in dairy farming, clean milk production, butter-making, soft and pressed cheese-making.

Horticulture.—The course of instruction is given in three terms, viz., an autumn term of 3 weeks, a spring term of 4 weeks, and a summer term of 4 weeks, and deals with the principles and practice of horticulture, being intended primarily for persons employed in garden work who propose to take up gardening as a profession. A teachers' gardening class, designed to qualify teachers for managing school gardens, is held on 12 Saturdays, from October till May, and during a fortnight in July.

External Lectures.—Single lectures or short courses of instruction are arranged at centres in the county. The subjects dealt with include agriculture, horticulture, cheese-making, fruit bottling, poultry management and beekeeping.

Advisory Work.—The Principal (Mr. R. M. Wilson) and members of the staff have many opportunities of co-operating with farmers, market gardeners, smallholders and others in the solution of farming problems which arise in connection with such matters as the cultivation of soils, farm machinery, rotations, manures and manuring of crops, food stuffs and feeding, milk production, dairying, breeding, rearing and management of live stock, management of orchards and apiaries, plant diseases and insect pests. Well over 1,000 inquiries on these subjects are dealt with annually. Several hundreds of samples of soils, manures, food stuffs, and dairy products sent in by farmers are analysed and reported on every year. The Institute deals with various farming problems through the "Essex Farmers' Journal," which is published monthly and is sent to 3,500 farmers.

Experimental work is carried out by the staff to demonstrate or investigate any matter of special importance to Essex farmers. Many farmers in the county help by providing facili-

ties or by carrying out experiments on lines suggested by the Institute staff.

County Organisations.—The Institute is fortunate in being closely associated with the following county organisations:—(*a*) The Essex Farmers' Union; (*b*) The Essex Agricultural Society, with which the Institute co-operates in clean milk production and various matters connected with its annual show; (*c*) The Essex Milk Recording Society, with which it co-operates in carrying out a scheme, having for its object the increased production of milk of high quality; and (*d*) The Essex Federation of Women's Institutes, for whom it provides lectures in various subjects. The Institute is also closely identified with allotment and horticultural societies throughout the county.

CUMBERLAND AND WESTMORLAND FARM SCHOOL, NEWTON RIGG, PENRITH.—This Institute is administered jointly by the County Councils of Cumberland and Westmorland. It was established in 1896, and provides accommodation for twenty-four students. A separate house for the Principal (Mr. R. Lindsay Robb) has recently been erected.

The courses of study are specially designed to meet the needs of the sons and daughters of the farming community of the two counties, stock rearing, dairying, poultry-keeping, and horticulture being given prominence in the curriculum. Special students are admitted for practical training in farm management. While the courses are designed for those who intend to farm, provision is also made for students who desire a more advanced course by the award of scholarships (tenable at Durham University, the British Dairy Institute, Reading, or other approved institution) to students of sufficient merit, enabling them to take a degree in agriculture or an advanced diploma in dairying. Women students are received from April to September, and male students from October to March.

Courses of Instruction.—A twenty weeks' winter course (October to March) is given in general agriculture. Instruction is given in live stock, crops, soils, manures, implements, machinery, dairying, agricultural science, veterinary science (including farriery), elementary surveying, book-keeping, building construction, and poultry keeping.

Three courses, varying from four to twelve weeks each, are given in dairying and poultry keeping. The syllabus

of the longest course embraces the science and practice of cheese-making, butter-making, production and handling of milk, feeding of dairy stock, elementary chemistry and bacteriology, with poultry keeping and domestic science as subsidiary subjects. The short courses are devoted chiefly to practical work in the dairy, with a few lectures on the principles underlying the practical work. These short courses also include poultry keeping, elementary horticulture and domestic science, and are designed to give the best all-round training to the womenfolk of the farm in the shortest time.

Newton Rigg is not at the experimental stage but has long since won for itself an important place in the sphere of agricultural education. Over 1,120 students have passed through the school, over 90 per cent. of whom have been absorbed into practical agriculture.

Farm and Stock.—The farm serves as the central experimental farm for the two counties. It lies on red sandstone and comprises 167 acres of good medium loam, 80 acres being arable, and 87 pasture. Extensive trials are carried out with different varieties of cereals and roots, and experiments are also conducted in the manuring of crops, the laying down of pastures, the manuring of grass land and the feeding of stock. A herd of dual-purpose Shorthorns is maintained with the object of grading up a heavy milking herd of pedigree stock, and a small flying flock of ewes of different crosses is kept, these being mated with rams of different breeds to make possible a comparison of the merits of different crosses for the production of fat lambs. A small pedigree herd of Cumberland pigs has also been established, and a few Large Black pigs are kept with a view to comparing the merits of these breeds when fed on the outdoor system.

Poultry Keeping and Horticulture.—During the winter months lectures on horticultural subjects are given at local centres, and short courses are arranged. In addition to an excellent fruit plot and vegetable garden at Newton Rigg, there are eight demonstration plots at Lyth, Brampton and Abbeytown where various experiments are conducted from time to time. Many visits are paid each year to private and school gardens, and the advisory work done by the staff in this connection is considerable. The allotment plot, which is cropped in accordance with the Ministry's scheme, has been a great success, and during the summer and autumn supplies vegetables regularly to the school.

The poultry department has proved exceedingly popular and many applications have been received from pupils desirous of specialising in the poultry industry. Pupils taking the dairy course have received a good training in the hatching and rearing of chickens by natural and artificial methods, the management of laying stock and—most important in the public eye—the dressing of table poultry.

The increasing popularity of the Institute is shown by the fact that the demand for admission exceeds the accommodation available.

CHESHIRE SCHOOL OF AGRICULTURE, REASEHEATH, NANTWICH.—Reascheath Hall and Estate was acquired by the Cheshire County Council in 1919. The Hall serves as a hostel for the staff and students, and the adjoining buildings have been converted into chemical and biological laboratories, lecture rooms, etc., on the most modern lines. The maximum number of students that can be accommodated is at present 41.

The Principal of the school is Mr. W. B. Mercer, and the staff includes lecturers in agriculture, farm chemistry and biology, horticulture, poultry keeping, dairying, and veterinary hygiene. A farrier and carpenter are also attached to the staff.

Courses of Instruction.—The main courses of instruction are in:—

Agriculture.—A winter course is held for about 22 weeks from October to March, and a supplementary summer course on a higher level) begins in April and lasts for 12 weeks. Everything possible is done to make the courses interesting to students, who, in addition to attending the ordinary lectures, laboratory classes and farm demonstrations, are given facilities to attend local markets and to visit neighbouring farms and other places of particular agricultural interest. One day in each week is devoted to practice in manual farm operations. Students are also accepted for training in practical farm work only.

Horticulture.—The winter course, from October to March, is followed by a supplementary summer course from April to July. Limited numbers of students are accepted for training in practical gardening only. Sixteen acres of ornamental and kitchen garden land with several ranges of glass houses adjoin the hostel, and a fruit plot of three acres has been established. A considerable number of experiments on garden crops are conducted annually.

Poultry Keeping.—Two 12-weeks courses of instruction are arranged, beginning in January and April respectively. The

poultry section covers 5 acres, and is fully equipped on modern lines, many of the houses having been built from designs supplied by the Ministry. A good deal of attention is devoted to artificial hatching, and large numbers of day-old chicks are supplied to residents in the county area. The instruction given includes the chemistry of foodstuffs, biology and joinery, in addition to practical poultry work.

The Farms.—Four farms are in the occupation of the County Council, viz., Reaseheath Hall Farm, Reaseheath Arable Dairy Holding, Henhull Farm, and the Worleston Dairy Institute Farm.

Reaseheath Hall Farm is approximately 200 acres in extent, including 54 acres arable, the remainder being permanent meadow and pasture. It is managed as a mixed holding. There is a herd of 35 non-pedigree milking cows, and the majority of the calves bred on the farm are reared; feeding of bullocks on the grass and in yards is practised, and a flying flock of sheep is kept. Breeding, rearing and feeding of Cumberland and Large White pigs is carried on. Field experiments are conducted on a fairly extensive scale.

The *Arable Dairy Holding* of 35 acres, 25 of which are arable and 10 pasture, is equipped with a very fine set of modern buildings. A concrete silo capable of holding about 150 tons of silage has been erected and admirable arrangements exist for testing the possibilities of arable dairy farming on a small scale. About 20 head of milking cows are carried, with young stock in addition, and the number is likely to be increased.

Henhull Farm adjoins Reaseheath Farm and extends to 210 acres, 75 acres being arable. Though worked in the main as an ordinary dairy holding, it is used for purposes of demonstration and experiment, whilst part of the practical work included in the curriculum is carried out here. A herd of 70-80 non-pedigree milking cows is kept, the milk being made into cheese on the farm. Large scale trials on the feeding of cows, and on the various arable crops are conducted, and as definite results emerge from the experiment on the arable dairy holding they are retested on a larger scale at Henhull Farm. Large numbers of pigs are reared and fattened.

Worleston Dairy Institute Farm.—Cheshire has for many years conducted a successful dairy school for women at Worleston, the dairy institute having been established in 1886 and taken over by the County Council in 1891. Three 14-weeks courses are held annually; the instruction given is mainly in

FIG. 1.—Cheshire School of Agriculture, Reascheath.

FIG. 2. The Laboratory.

FIG. 3.—Cheshire School of Agriculture, Reascheath. A Stock Judging Class.

FIG. 4. Part of the Fruit Plantation.

the making of Cheshire cheese. There is hostel accommodation for 20 students and about 40 pass through the school every year, many taking more than one course. The farm covers 180 acres of grazing land, the soil being heavy clay and not suited to arable cultivation; from 70 to 80 acres are mown annually. The farm is well equipped with buildings, and a herd of 60-70 good class commercial cows is kept. Large numbers of pigs are reared annually.

LLYSFASI FARM INSTITUTE, RUTHIN, DENBIGHSHIRE.—The Denbighshire Education Committee purchased for the purposes of their County Farm Institute, which was opened in May, 1920, a farm known as Llysfasi Manor Farm, situated 4 miles from Ruthin at the upper end of the Vale of Clwyd. The ancient farmhouse, now modernised and equipped with the latest conveniences, provides residential accommodation for 14 pupils, but more students can be admitted to the Institute, as sleeping quarters can be secured in the immediate vicinity.

Mr. Isaac Jones, formerly lecturer in agriculture at the University College of North Wales, is Principal of the Institute, and is assisted by a staff of five instructors and instructresses in various subjects, who, in addition to the school work, are engaged in conducting lectures and classes in agricultural subjects at centres in the county.

The Farm and Stock.—The farm is well supplied with timber and water and extends to 600 acres. About one-third of this acreage is very fertile soil lying in the vale, while 200 acres is more hilly land and poorer in quality, but fairly representative of the usual type of soil in the upland districts of Wales. The remaining 200 acres is rough sloping ground, rising gradually from 300 ft. to 1,000 ft. and suitable only for carrying ponies, matured store stock, and sheep.

The system of farming engaged in is of the mixed type, with a leaning towards dairying, a considerable quantity of milk being necessary to meet the requirements of the school dairy. About 30 dairy cows are maintained, together with 50 head of young stock, including both the Shorthorn and the Welsh Black breeds. Milk records are taken and the herds are being improved by selection. A flock of over 600 sheep is maintained, mainly of the Welsh Mountain type, but including small flocks of the Southdown and Improved Welsh sheep.

Experiments are conducted on the farm in connection with seed mixtures, manuring, feeding, etc., and the results obtained

are explained to the students. In this way the student is able to appreciate the value of different methods adopted for dealing with various problems.

Courses of Instruction.—Four courses, each of 10 weeks' duration, are arranged at the Institute during the year—two for men and two for women. An examination is held at the end of each course on the result of which certificates are awarded to those who reach the required standard. In the autumn course for men, instruction is given in agriculture, agricultural chemistry and botany, veterinary hygiene, land surveying, book-keeping, horticulture and dairying, and a more advanced continuation course is arranged in the winter for students who are able to remain at the Institute for the longer period, some of whom may desire to proceed to a University College.

A course in dairying, horticulture and poultry keeping is held in the spring for farmers' daughters and other women interested in rural industries, while a continuation course in the same subjects is conducted in the summer to meet the needs of women students who desire to secure posts as dairymaids or cheese-makers at factories, or who may wish to enter a University College in order to qualify for the National Diploma in Dairying.

The Education Committee offer a limited number of scholarships to residents in the county who wish to attend courses at the Institute, and, on completing their course at the Institute, students from the county may compete for scholarships tenable at Bangor College. It is therefore possible for a student to proceed from the Institute to the University and take a degree course.

It should be borne in mind, however, that the instruction provided at the Institute is designed primarily to enable the young men to make a living by farming. Too much emphasis cannot be laid on the practical side of the work conducted at the Institute. The various operations on the farm afford an opportunity for impressing upon students the importance of applying science to practice.

The belief so prevalent in the rural districts of Wales not long ago that education was a luxury in the case of the cultivator of the soil no longer exists, and the establishment of Institutions such as the one at Llysfasi shows that the agricultural community realises the advantage of a training at a Farm Institute for equipping a young man for life on a farm.

THE FATTENING OF CATTLE.

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A BULLETIN of more than ordinary interest on the above subject,* published by the Agricultural Experiment Station, University of Minnesota, U.S.A., in 1920, has recently come to hand.

The mass of new and interesting data presented is almost overwhelming, and only a very brief notice is here possible. The experiments described in the publication began in 1907. In all 189 head of cattle were employed. Of these 63 were slaughtered at various stages from 100 lb. to 1,500 lb. live weight. Complete analyses of the bodies of these animals were made, the data including details of the composition under such heads as Flesh, Edible Offal, Bone, Blood, etc. So far as this country is concerned, the only data of this sort published relate to *three* beasts only, slaughtered and analysed by Lawes and Gilbert at Rothamsted in 1849.

A unique feature of these experiments, however, is that all the food employed from beginning to end was weighed and analysed so that we have presented in this bulletin not only the composition of the steers at each stage (each 100 lb. increase of live weight) but also the analysis of all the food consumed up to each stage in terms of protein, fat, etc. In all 52 elaborate tables of figures are given, but, unfortunately, the letterpress with which they are accompanied hardly does justice to the unique value of the data which the investigation provides. The two accompanying figures have been constructed to illustrate roughly some of the more outstanding results.

Fig. I embodies some of the data obtained by analysing the bodies of steers slaughtered at stages of 100 lb. from 100 to 1,500 lb. live weight. It shows in a graphic manner that:—

1. After 600 lb. the fat laid on the edible portions of the carcass rapidly increases, whereas the protein (roughly dry matter of the lean meat) increases slowly and proportionately to the increase of live weight.

2. The rate of fat deposition begins to increase very rapidly after 900 lb. is reached.

3. Contrary to the usual opinion, the rate of fat deposition in the offal is slower than that of flesh fat, and in absolute amount is comparatively insignificant at all stages.

* Investigations in Beef Production—University of Minnesota. Bulletin 193—T. L. Haecker.

Fig. II has been prepared to illustrate a feature of beef production which came into prominence during the War—the "waste" of food involved—especially in the later stages. The upper curve shows the total quantity of food consumed (from calfhood) by a steer at each stage in the fattening process. For example, a steer of 1,000 lb. (9 cwt.) live weight was, on the average, 600 days (20 months) old and *up to that time* had consumed in all nearly 6,000 lb. of food, or 6 times its weight, expressed as dry matter: whereas a steer in reaching 1,400 lb. live weight, consumes 3,000 lb. more food, or 9,000 lb. in all, equivalent to nearly $6\frac{1}{2}$ times its own weight.

Combining this graph with the first, it is obvious that this additional 3,000 lb. practically entirely goes to increasing the fat of the flesh.

It should be noted that in these experiments the animals were stall-fed from calfhood. They must have all been excellent "doers," for 1,400 lb. was reached on an average in 25 months. Nor was the feeding extravagant. At the 1,000 to 1,100 lb. stage the ration was only 17-18 lb. dry matter *per diem*, or in terms of actual materials, $9\frac{1}{2}$ lb. grain, 7 lb. hay and $13\frac{1}{2}$ lb. silage. At 1,200 lb. the steers were graded in the market from "choice" to "prime" fat and sold at good prices.

It may be of interest to note also that the "fat ox" of the Rothamsted experiments in 1849 was found on analysis (at 1,400 lb. live weight) to contain 30 per cent. of fat. At the same live weight these American animals contained on an average 28 per cent. of fat.

In regard to this matter of beef production, there still remains, however, one matter requiring investigation. We have no experimental evidence on one important point. We do not know what degree of fatness of the body (or of the flesh) as a whole is necessary in order to secure the ideal joint from the point of view of the butcher and the cook. The extraordinary wastefulness of securing the last 400-500 lb. of fat in the body as a whole is placed beyond all doubt by these experiments. But it may be that until the total fat is pushed to 30 per cent. the ideal joint with its appetising mixture of marbled fat is not produced. On the other hand, it may well be, as maintained by the Cambridge workers, that "baby" beef provides everything that the butcher and cook desire. But the matter cannot be settled in the absence of further experimental work, such as, it is understood, is now proceeding at Cambridge.

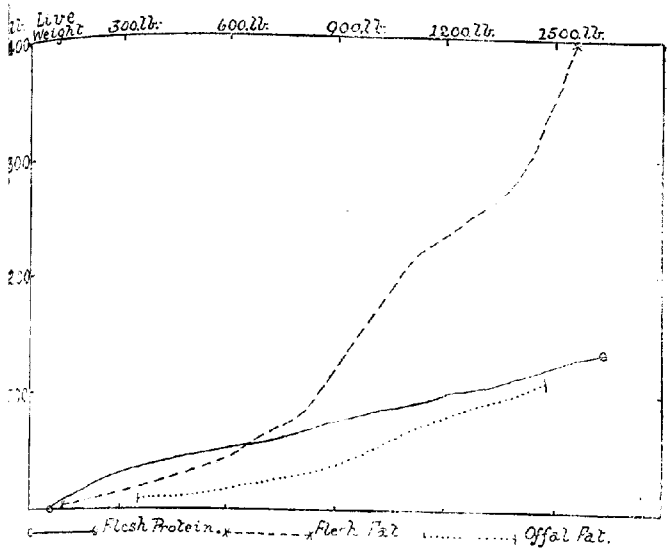

FIG. 1.—Composition of Body at different weights.

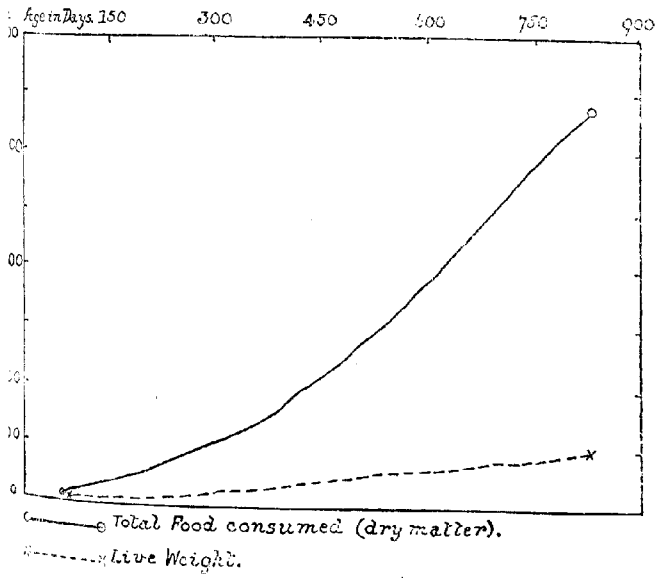

FIG. 2.—Total consumption of Food to different ages.

In the meantime, the Bulletin under notice will repay the careful study of investigators and agriculturists, containing, as it does, a mass of new and accurate data on a much debated problem.

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THE COST OF MANUAL LABOUR IN MILK PRODUCTION.

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THE labour bills in the cost of milk production may be divided into (1) *direct* and (2) *indirect charges.*

The *direct* charges will include the cost of labour required for direct attention—milking, feeding, grooming, cleaning out the byres, bedding down the cows, scalding and cleaning the milk utensils and attention to the stock bull.

The *indirect* labour charges will include the cost of the labour utilised in the production of that part of the home-grown foods fed to the cows.

Since the year 1908, considerable time and attention have been devoted in the Department of Agriculture of the University of Leeds, to investigating the varying costs of milk production in a large number of herds in different parts of Yorkshire. As a result of these investigations it may be stated :—

a. That one man has on the average been fully employed

during the winter months in direct attention to	...		...	12 cows.
during the summer months to	...	...	...	18 cows.
and during the whole year to	...	...	...	16 cows.

In other words, each cow has on the average required for direct attention the whole-time labour of one man for 23 days per year.

b. That each cow has had on the average the grazing of 1·5 acres of grass and consumed, in addition,
18 cwt. of *purchased food*,
15 cwt. (or the produce of 0·6 acres) of *hay*,
15 cwt. („ „ „ 0·3 „) „ *straw*,
and 4 tons („ „ „ 0·2 „) „ *roots*.

During the twelve months 1919-20, when 22 Yorkshire herds were being costed, the total labour bill per cow direct and indirect amounted to £13 6s. 11d., and was made up as follows:—

	HORSE.	MAN.	
a. Direct Labour in attention to each cow			£10 3 4
b. Indirect Labour	s. d.	£ s. d.	
i. Employed on 1·5 acres of grazing land	5 2	0 9 3	
ii. In production of 15 cwt. of hay ...	6 1	0 11 4	
iii. „ „ „ 15 „ of straw	3 3	0 15 0	
iv. „ „ „ 4 tons of roots ...	7 6	1 8 0	
			£3 3 7
	HORSE.	MAN.	
Total Labour Bill per cow per year	£1 2 0	£13 6 11	

TABLE I.—THE AVERAGE YEARLY MAINTENANCE COST OF A COW, 1919-20.

	Average yearly cost of upkeep per Cow, 1919-20.	Cost per Gallon of Milk.	Percentage cost.
	£ s. d.	£ s. d.	
Purchased Food Stuffs	20 0 6	0 0 8½	38·5
Man Labour Bill—*a.* Direct	10 3 4	0 0 4½	19·6
b. Indirect	3 3 7	0 0 1¼	6·1
Horse Labour	1 2 0	0 0 0½	2·1
Depreciation of Cows	8 0 0	0 0 3½	15·4
Tradesmen's Bills, including seed and manure of home-grown foods fed to cows	5 9 4	0 0 2¼	10·3
Rent and Rates of Land and Buildings	4 2 9	0 0 1½	8·0
	£52 1 6	£0 1 10	100·0

That the man labour bill is an important factor in the cost of milk production will be seen from the figures in Table I. which show that in the year 1919-20 it amounted to approximately 6d. per gallon, and represented nearly 26 per cent. of the total yearly cost of maintenance of each cow. With the present fall and the probability in the near future of a still larger fall in the price of milk, the milk producer will have carefully to study his labour bill if he is still to make the production of milk a remunerative transaction. As he will naturally be unwilling to bring down the actual weekly wages of his men lower than is absolutely necessary it will be to the better organisation of that labour and the adoption of more or less simple labour saving

vices that he will in a large number of cases have to look in
er to effect the necessary economies.

During the year 1916-17, in the 14 herds then under observa-
n 15 per cent. of the total cost of production of milk could on
e average be charged to the total labour bill. At that time
e average labour bill worked out at £2 10s. 0d. per cow during
e summer months, and £3 3s. 0d. per cow during the winter
nths, or £5 13s. 0d. per cow per year; the weekly labour bill
r cow averaged 1s. 11d. in the summer, 2s. 5d. in the winter,
d 2s. 3d. all the year round, and the average labour bill per
llon of milk corresponded to $1\frac{3}{4}$d. during the summer months
d $2\frac{1}{2}$d. during the winter months.

In the individual herds during that year, the influence of the
our bill upon the cost of milk production varied very consider-
ly, from £4 4s. 3d. per cow per year (or 1s. $7\frac{1}{2}$d. per week)
£10 7s. 9d. per year (or 4s. per week), and from $1\frac{1}{2}$d. to 4d.
r gallon of milk produced.

At that time, as one would naturally expect, the wages of the
en varied considerably on different farms, actually from 26s.
40s. a week, being higher in the vicinity of the coal-mining
ts and the manufacturing towns where the competition for
bour is keener. Still, this variation in the wages bill per head
as not so important a factor in influencing the cost of milk
oduction, as the relative amount of labour employed in attend-
g to the cows, which, unlike wages, is not determined by the
ographical position of the farm.

Thus in *Herd O* during the summer months of 1917 one man
as employed quarter time, and a second man was employed
ne-fifth time in attending to 13 cows: an equivalent of one
an fully employed for every 29 cows.

In *Herd L* in attending to 36 cows for the corresponding
eriod two men and one boy were employed full time, and one
an one-third time: an equivalent of one man fully employed
r every 14 cows.

In a well managed herd, the labour employed should not be
etter than an equivalent of one man fully employed for every
8-20 cows in the summer and one man fully employed for every
2-14 cows in the winter.

Actually, as will be seen from Table II, the number of cows
ttended to by one man varied on the different farms from 29
o 14 during the summer months and from 16 to 10 in the
inter months.

TABLE II.—VARIATIONS IN AMOUNT AND COST OF MANUAL LABOUR IN MILK PRODUCTION.

Herd No.	Average No. of cows attended to by one man.		Cost of labour per gal. of milk produced.			
			1916–1917.		1919–1920.	
	Summer.	Winter.	Summer.	Winter.	Summer.	Winter.
O	29	16	1d.	1¾d.	2d.	4¾d.
C	23	16	1¼	2	2½	3¾
W	21	14	1½	2½	3	4¾
T	20	14	1½	2¾	3½	5
K	17	13	1¾	3	3½	5½
N	17	12	1¾	3	3¾	6
OA	16	12	1¾	3	3¾	6
I	15	11	2	3	5	7½
L	14	10	2¼	3¼	5½	8½
S	14	10	2½	3¼	6½	10¾
G	14	10	2¾	3½	10¼	10½
Average	18	12	2	3	4½	7

In 1916-17, when the average wages of a man on the farms "costed" were approximately 35s. a week, the wages bill per cow should rarely have exceeded 2s. per week in the summer or 3s. per week in the winter. In 1919-20 when wages were up to £3 and in many cases to £3 10s. 0d. per week, the yearly labour bill per cow, if that labour were properly organised, should rarely have exceeded £12 a year, or 4s. a week during the summer months and 6s. a week during the winter months; and where cows were giving a normal yield of from 500-550 gallons, the labour bill should not have added to the cost of milk production more than 4d. a gallon in the summer and 6d. a gallon in the winter, nor should the bill for *direct* labour have been responsible for more than 20 per cent. of the total cost of milk production.

In *Herd F* in the year ending 30th March, 1920, the labour bill per cow amounted to no less than £23 4s. 8d. per year, or 7s. 11d. per cow per week during the summer and 10s. 0d. per cow per week during the winter months; and in spite of the fact that the milk yield was particularly high, averaging 755 gallons per cow, the labour bill added 5½d. per gallon during the summer and 8¼d. per gallon during the winter months to the cost of production of milk.

In *Herd D* where the milk yield amounted only to 450 gallons per year, and the yearly labour bill per cow was £16 19s. 2d., this labour bill added a cost of 6½d. per gallon in the summer and 12¾d. per gallon in the winter.

In *Herd G* where a high yearly labour bill per cow of £16 14s. 5d. was accompanied by a low milk yield of only 360 gallons per cow, the labour bill added a cost of 10¼d. a gallon to the milk in the summer and 12½d. a gallon in the winter.

A milk producer may, as has already been stated, have to pay relatively high wages for attention to the cows, but where, as in the case of Herds S and G, that labour was not utilised to the best advantage, the management has apparently been at fault somewhere.

In the herds which have been under observation during the last nine or ten years, it has been interesting to note the various more or less successful attempts which have been made by the various owners to solve their special problems in trying to minimise the high labour costs in milk production.

On Farm B, a North Riding mixed farm of 318 acres (168 arable and 150 grass) on which between 50 and 60 milch cows are kept and milk is produced all the year round, the introduction of a Lister milking machine has proved very successful in reducing the *direct* labour costs of the herd.

Labour sheets kept on the farm show that in 1914, before the introduction of the milking machine, each cow kept the equivalent of one man fully employed in direct attention 26 days per year. During the year 1920-21, in spite of the shorter hours worked per day, each cow utilised in direct attention the equivalent not of 26 but 23 days' labour of a man. As the wage books show that during last year the wages of the cowmen on the farm averaged 9s. 6d. per day, and as the cows in the herd averaged 565 gallons per head per year, one might be justified in assuming that on that particular farm the introduction of a milking machine had resulted in reducing the wages bill in attention to each cow by about 28s. 6d. per year; and in reducing the cost of milk production by rather more than ½d. per gallon. Observations on other farms have led to the conclusion that unless the herd contains at least 40 cows, the reduction effected in the wages bill in attention to the cows has not justified the expense of the installation of the necessary plant.

On Farm F.W., a mixed farm in the North Riding of just over 800 acres (52 per cent. arable, 48 per cent. grass), on which milk production is the dominant feature, the economy of labour has been carefully and scientifically studied. The eldest son of the owner turned his engineering skill and ability to the easing of the

labour question on the farm. Attention was first paid to an old set of buildings which were at small expense adapted for use as a root house, cake house and straw chamber. Trolley lines were laid down in concrete made on the premises, along which the chopped roots, broken cake, meal mash and chop could be wheeled direct to the byre. The trolleys, substantially made, after the fashion of those used in the coal mines, were made on the premises under supervision. In 1916 a new byre with fittings and stalls for 40 cows was erected. It is fitted with a very efficient system of ventilation, the cows stand tail to tail, the trolley lines lead direct from the buildings beyond into each feeding passage of the byre, and the manure can be easily and readily got rid of by means of an overhead trolley system, leading to a small covered yard well away from the byre. From the byre there is a gentle slope down so that the full trolley is carried to the covered yard almost by its own weight, automatically empties itself and can, when required, be pushed back empty to the byre, with very little trouble. The trolley can be lowered by means of a chain lever for filling and again raised to any convenient height when sent to empty itself. Each cow has its own separate stall provided with simple and ingenious devices for preventing the cow from stealing her neighbour's cake, for automatically supplying herself with a constant supply of fresh drinking water, and for making it easy for her to be quickly and securely fastened, while yet leaving her sufficient freedom of movement.

A high standard of cleanliness is maintained; the milk produced is Grade A; and an extra 4d. a gallon over and above the varying local price is always paid for all milk coming from the herd.

A milking machine, the Amo, has been in use for five years and is found to work very satisfactorily, great care being taken to keep it scrupulously clean. Leading from the byre is a small room fitted with a weighing dial for recording the individual milk yields; after weighing the milk is poured into a hopper and passes directly into the receiver and cooler on the other side of the partition; the 17-gallon milk churns stand on a small weigh-bridge so that the total weight of milk sent out can be quickly and readily obtained. By these means also the milk is quickly removed from any possible source of contamination in the byre and under such conditions should leave the steading in a very " clean " condition.

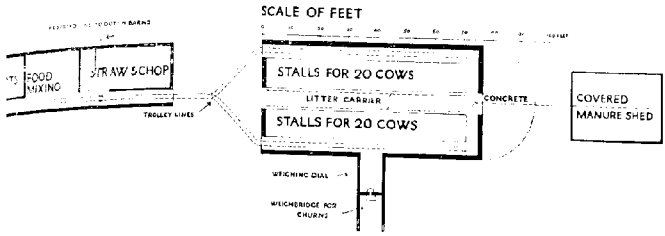

FIG. 1.—Ground Plan of Farm Building.

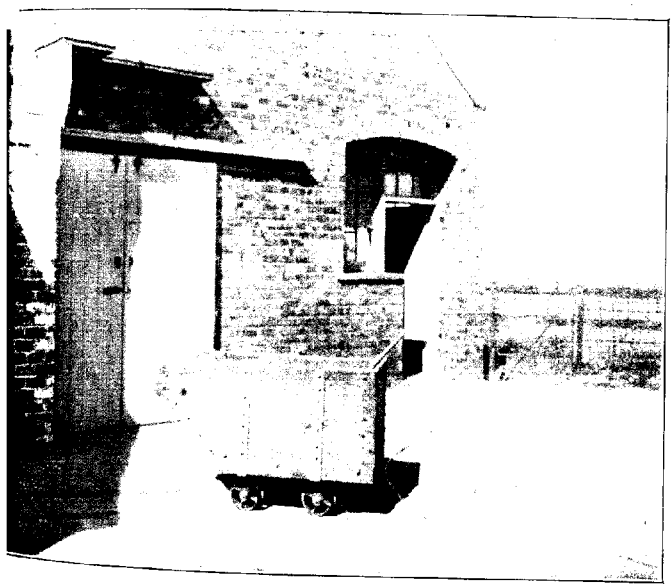

FIG. 2.—Showing Trolley-way to Feeding Passages of Cow-byre.

FIG. 3.—Interior of Cow-byre, showing Overhead Trolley system for removing manure.

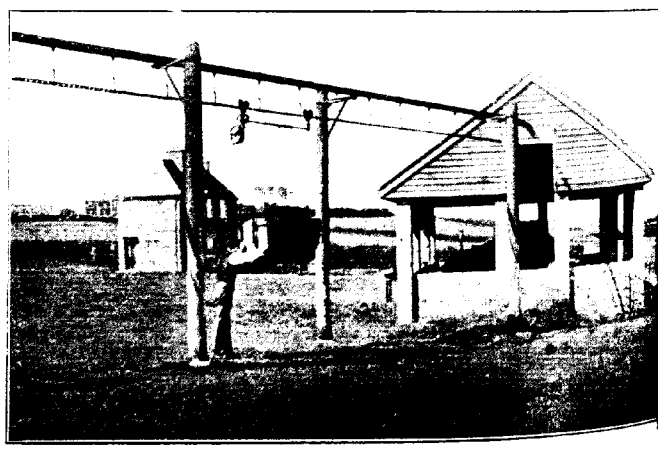

FIG. 4.—Covered Manure Shed with Overhead Trolley system from Cow-byre.

The men on the farm are well paid, and have every third Sunday off in addition to their half-day holiday a week; yet in spite of the precautions taken to get clean milk the labour bill per cow per week is comparatively low. In December, 1921, in attending to 105 total head of stock (40 milk cows, 2 bulls, 14 calving heifers, 14 feeding bullocks, 14 heifers 1-2 years, and 21 yearling heifers) there are employed :—

1 stockman	at	£3	5	0	per week.
1 man	„	2	12	0	„ „
1 land girl	„	2	0	0	„ „
1 woman, part time	„	0	10	0	„ „
1 odd man on Sunday	„	0	6	0	„ „
At a total cost of		£8	13	0	„ „

of which, when £7 per week is charged to the cows, the labour bill in direct attention amounts to 8s. 6d. per cow per week, or 3d. per gallon of milk produced.

In many parts of Yorkshire, particularly the industrial area of the West Riding, and to a smaller extent some parts of the North Riding, milk producers have been heavily handicapped as far as their labour bill is concerned by the fact that the whole holding is subdivided into a series of small divisions each with its separate sets of buildings. Thus in the case of Farm P, a farm of 125 acres (90 per cent. grass) in the West Riding, the land was a few years ago rented under 10 different landlords, and the herd of 50 cows was housed in five distinct sets of buildings each two or three hundred yards apart. The lighting of these farm houses, with their three sets of windows on the ground and first floor respectively, suggests that each original small holder was partly engaged in the occupation of farming and part of his time taken up at the hand looms, many of which are at the present time still in existence in the neighbourhood. Up to quite recently the labour bill in the production of milk on Farm P has been particularly high, partly because of the high rate of wages which has to be paid in the vicinity of an industrial town and partly because of the uneconomic use made of that labour, when the cows were distributed over five sets of buildings. On this farm the labour bill in direct attention to 50 cows amounted in 1920 to £18 5s. 6d. per head per year, or 1s. 0d. per cow per week, and 8½d. per gallon of milk produced. On the adjacent holding, which was bought by the tenant some five or six years ago, wooden buildings have been erected out of material obtained from the disposal sales in which 40 cows can be stalled under

one roof. As a result of the economy of labour thus effected the labour bill per cow on this farm was last year about eighteen per cent. lower than that on Farm P.

On Farm H, a small farm of 92 acres (59 arable and 33 grass), in the North Riding, which was taken over by the present tenant three years ago as practically a derelict farm, a good deal of thought and ingenuity has been made use of in adapting to modern requirements, at very little cost, old and dilapidated buildings. A small six horse-power Powell paraffin engine with magneto ignition, root cleaner and pulper, cake crusher mill and chaff cutter, together with the necessary gearings, were picked up cheaply second hand and fixed by the tenant himself at a total cost of under £130. On this farm, on which before 1918 the arrangements for the feeding of stock were exceedingly primitive, no single labour-saving device existing, in 1919 in attention to 12 cows the labour bill amounted only to £6 1s. 1d. per head, 2s. 4d. per head per week, or 2½d. per gallon of milk produced.

Farm CA.—Perhaps one of the greatest improvements as far as the economising of labour in attention to stock is concerned has been made on Farm CA. When first we got in touch with the farm some three years ago the implements and machinery certainly needed bringing up to date. The engine used for grinding was a beam engine dated 1808, with a fly wheel 12 feet in diameter. The boiler—fitted with no tubes—was 21 feet in length. The extravagance of the fuel consumption can be gauged from the fact that it was always necessary to start getting up steam the day before it was intended to use the engine for grinding. The grinding was done between millstones; there was no chaff cutter or root pulper or slicer on the premises, straw being fed long and roots fed whole; cake, however, was broken in a machine which had been devised and used for crushing bones in the days before bone meal and steamed bone flour were on the market.

In May, 1921, the old engine and plant were scrapped and sold for £56 10s., the fly wheel of the engine having to be broken up with dynamite charges before it could be removed! A gas engine, root cleaner and pulper, chaffing machine, mill and cake crusher, with the necessary gearings, were purchased for £192 5s. 0d., and fixed by means of the labour on the farm at a total net cost of £307 6s. 2d. for engine, machinery, material and labour after allowing for the £56 10s. 0d. received on the sale of the old plant.

While the improved system has not been long in operation, and it is perhaps early days to talk definitely of the economic advantages which have accrued, it may be stated that for the quarter ending 30th September, 1921, the gas consumed in running the engine amounted only to 1,100 cubic feet at a cost of 8s. 7d., and that while the labour bill in attending to the cows amounted in January, 1921, to 6s. 5d. per cow per week, or rather more than 6½d. per gallon, these costs at the present time are certainly twenty-five per cent. lower.

* * * * * *

THE PLANNING AND CONSTRUCTION OF COW-SHEDS.

II.

COVERED YARD AND MILKING SHED AT THE NATIONAL INSTITUTE FOR RESEARCH IN DAIRYING, READING.

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THE July number of this *Journal* contained an article on the construction of modern cow-sheds, and though the sheds illustrated contained some novel features, they followed the traditional method of keeping and milking cows in one building. Through the courtesy of the Board of the National Institute for Research in Dairying, and of Mr. Hutt, of Messrs. Charles Smith & Son, Architects to the Institute, it is possible in this number to describe and illustrate the plans of the new farm buildings which the Directors of the Institute are about to erect at Shinfield, near Reading. The most interesting point in these plans is that the method about to be adopted by the Institute embodies another principle in cowkeeping. The traditional cow-shed method is discarded in favour of the principle of keeping and feeding the herd in covered yards, milking being performed in a building erected solely for that purpose.

From the practical and structural point of view, this departure from tradition is of great interest and importance, coming, as it does, at a time when the necessity for improved methods in the production of clean milk is being increasingly realised, and many farmers are anxious to know what steps they can take to secure better conditions without undue capital expenditure.

Two points must, however, be borne in mind in connection with this scheme: (1) the fact that the method adopted is distinct in principle from the ordinary practice, and (2) that the peculiar needs of a Research Institute, where experiment and trial are the root factors, do not necessarily apply to ordinary commercial farming. Nevertheless, the plans offer some food for thought, and to those who own extensive but out-of-date and inadequate buildings, the suggestion may be of value that improvement for commercial purposes could be inexpensively undertaken on similar lines to those deliberately adopted by the Institute authorities.

There must be many farms where existing cow-sheds, no longer in conformity with modern ideas and methods of clean milk production, could be cheaply converted into milking sheds, and where, by the adaptation of an open yard into a covered yard somewhat on the lines of the plans shown, ample provision could be made for the accommodation of a considerable herd of milking cows; and at less cost than building a modern cow-shed for the same number.

Description of Plans.—Fig. 1 shows the general lay-out of the existing and proposed new buildings. It may be said that the old farm buildings are typical of thousands throughout the country, and though, at the present time, it is found possible to produce Grade A milk, it is doubtful if, under the physical conditions obtaining, it would be a commercial possibility, winter and summer, day in and day out, were it not for the never-failing vigilance and care of the Institute staff.

The fact that it is possible to produce Grade A milk under the existing conditions is a clear indication that it is the human element which is the most important factor, and that it is not elaborate or costly buildings alone which produce the desired results.

Reference to the site plan shows the relationship of the various new buildings, hatched in on the plan, from which it will be seen that these comprise a large farm steading, a milking shed, lavatories and cloak rooms, and a dairy. The new animal house and the other Institute buildings do not come within the range of the present article, which is intended rather to emphasise the principle adopted and call attention to the fact that such principles might be applied to existing buildings with comparatively little expense.

Fig. 3 shows the plan and general distribution of the main farm buildings, which in effect follow the traditional arrange-

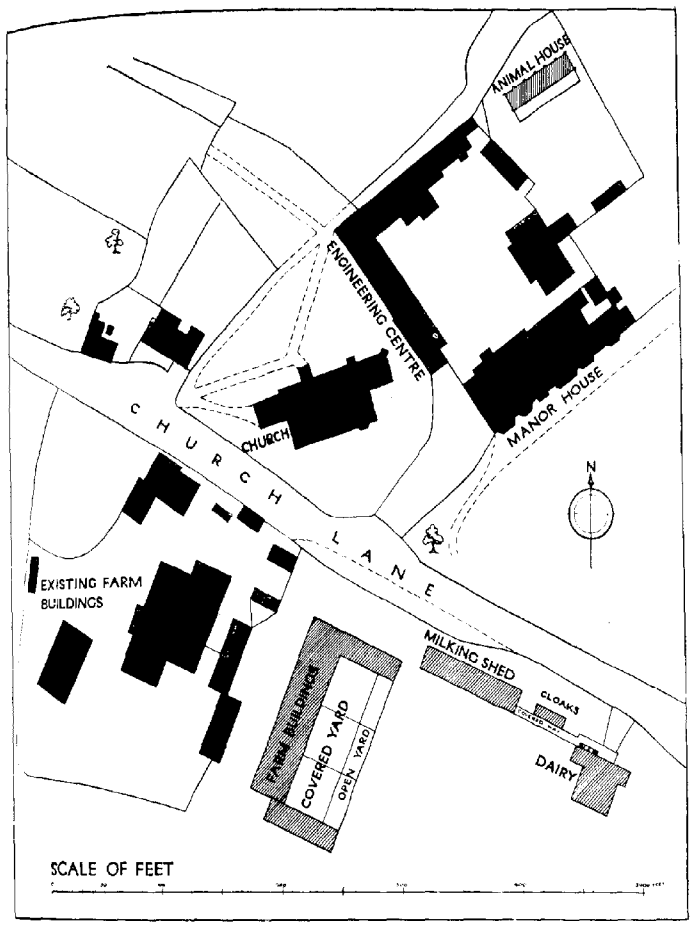

FIG. 1.—The National Institute for Research in Dairying, University College, Reading Block Plan.

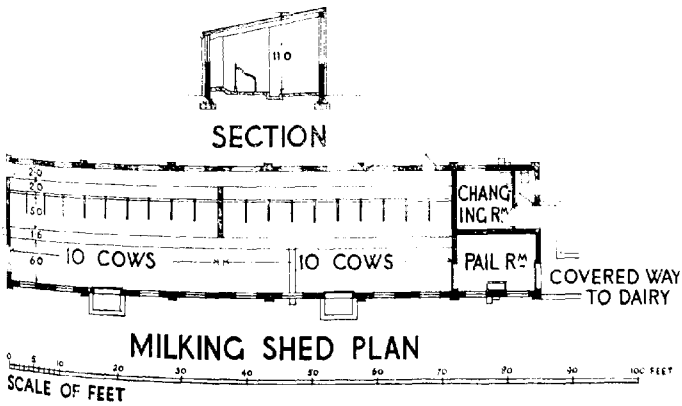

FIG. 2.—Plan and Section of Milking Shed.

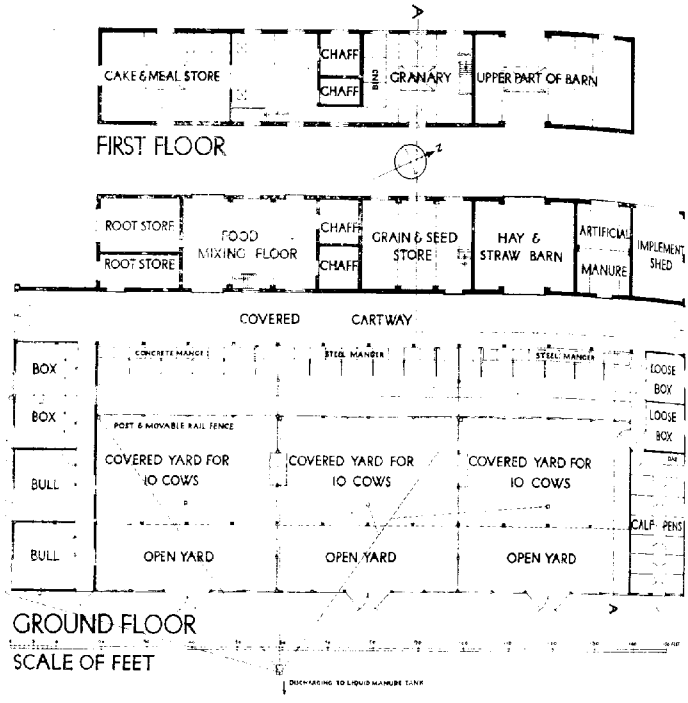

FIG. 3.—Plan of Main Farm Buildings.

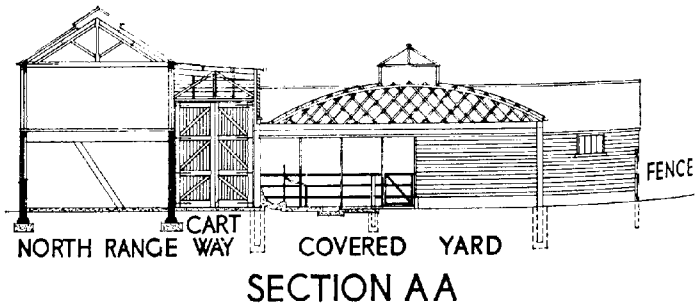

FIG. 4.—Section through line A A on Fig. 3.

ment, being grouped round the three sides of a square with the big covered yard in the centre.

To the north-west is placed the barn range, a brick-built and slated building, arranged for the concentration, preparation, and easy distribution of fodder of all kinds. The planning and arrangement of this building are practically normal, and call for no particular comment save that the upper floor will be constructed of fire-resisting materials with a grano paving finish. One of the distinguishing features of the plan is the covered cartway connecting the main range with the covered yard and stock sheds. The roof of this cartway, the stock boxes, and covered yard will be constructed in creosoted timber framing with felted roofs, as it is considered that these buildings thus constructed are more readily adaptable to meet changing conditions or the special needs of experimental work, as well as being less costly to erect.

The covered yard is, for the special purposes of experimental feeding and recording, divided into 3 equal portions each designed to accommodate 10 cows.

Mangers and standings for the 30 cows are placed immediately abutting upon the covered cartway and in close proximity to the administrative range, thus allowing for the most labour-saving means of attendance upon the animals. A post and movable rail fence separates the standings from the remainder of the covered yard.

The covered yard is roofed by means of Belfast truss principals at 12-foot centres with a clear span of 35 feet. The containing fence on the south side is placed 14 feet beyond the span of the roof, thus allowing some open yard area where stock can obtain full advantage from the sun. The floor of the yards will be of 6-in. rammed chalk.

The boxes on the south side have been designed with the intention of ultimate conversion to double cowstandings by the addition of another bay to the main Belfast truss roof, which is extended on this side to include the range of boxes. On the opposite side, to the north, a low span-roof building contains 2 boxes and a number of calf pens.

Drainage from the standings and covered yard is collected in a manure tank.

Thus it will be seen that the general arrangement of the buildings themselves is quite on traditional lines, save that it is perhaps more usual to find a central range separating covered or open yards. In such a case, were conversion

required, it might be possible to sacrifice the central range entirely, and convert the whole space between the flank ranges into a covered yard. The provision of a cartway on the south side of the barn range might be achieved in many cases by continuing the slope of the main north range roof where the range is a lofty building, as is so often the case.

It is only possible to suggest the main lines of such a conversion, but to anyone familiar with farm buildings the possibilities of following the general principles exemplified in these plans will be obvious.

The Milking Shed.—The site plan shows the milking shed, shown in Fig. 2, placed to the east of the main buildings. This shed has accommodation for 20 cows, and will be built in brick with grano floor, cemented walls and reinforced concrete slabbed roof, so that the whole building may be hosed down.

As cows will only be there for the short period of milking, the cubical content is of little importance and hence the shed has been designed on the most economical lines, so far as size is concerned. A narrow feeding passage 2 ft. wide is provided to facilitate the rapid placing of the cake or other foodstuffs consumed by the cows during milking. At the end nearest the dairy, provision has been made for a changing room with lavatory basin and a W.C. with external access from the covered way connecting the dairy and milking shed. A small pail room with a sink entered direct from the covered way and milking shed is also provided. The milk will be taken from the milking shed to the platform and poured into a receiver outside the cooling room of the dairy.

For general convenience the plan is hard to improve, and it is hoped that its publication will be of interest, not only to those who are considering the possibility of making alterations to their own buildings, but also to all who are interested in the progress of scientific farming, and particularly in the work which the National Institute for Research in Dairying is doing.

A future article will deal with the great advance in the production of clean milk which is being made in the Reading district under the guidance of the Institute.

* * * * * *

THE BRITISH FRIESIAN.

GEORGE HOBSON.

MANY of our native breeds of cattle were influenced by importations of Dutch stock, particularly during the 17th and 18th centuries, and large numbers of black-and-white Dutch cows were imported in the 19th century, especially in the 'seventies and the 'eighties. They were distributed chiefly over the counties on the east coasts of England and Scotland, although the best herds were probably preserved in other districts. With the passing of the Act prohibiting the importation of live cattle except for purposes of immediate slaughter, further landing was stopped. The breed, however, was not allowed to become extinct, and in 1909 a society was formed with the object of developing it and fostering its interests. The society was permitted in 1914 to obtain an infusion from Holland of much needed new blood; and the subsequent rapid progress of the breed is remarkable in the history of pedigree live stock. In 1911 the membership of the society was not more than 50. In 1922 the membership of the British Friesian Cattle Society is 1,950 or nearly forty times greater than ten years previously.

British Friesian cattle are similar to, if not so wonderfully uniform in breed character as, the world-famed Friesians of the Netherlands, and to the equally noted Holstein-Friesians of America, where this race holds all world's records for milk and butter production.

Improvers of the Breed.—Although much of the wonderful improvement in the conformation, symmetry and breed character of British Friesians is directly due to the influence of the animals imported from Holland in 1914, the work of the few breeders who practically prevented the extinction of this valuable variety of stock was of incalculable benefit, and the animals bred by, and descended from the strains owned by, these early pioneers have supplied the large majority of the numerous 2,000 gallon cows of the breed. Mr. John Twentyman, of Hawkrigg in Cumberland, developed a good herd in the latter years of last century, and from Hawkrigg went the cows that founded the well-known Colton herd of Mr. Hugh Brown. Two of the Hawkrigg bulls, Royal Duke and his son Hedges Hawkrigg Duke, proved two of the strongest pillars of the first Herd Books and two of the best and most impressive bulls in the breed. After twenty years the influence of Royal Duke in leaving big animals

and exceptional milkers can be traced in his descendants. Another early herd that proved of great assistance to pioneers was that of Earl Egerton of Tatton, who bred Hedges Tatton King, a bull used by Mr. Hugh Brown, of Colton, and by his brother, Mr. John Brown, of Hertford (later of St. Albans). After the Hawkrigg and Tatton herds had been dispersed, the breed was preserved by these two brothers, who developed the Colton and Hedges herds, the latter still in existence, to make history for the black-and-white cattle.

General Appearance.—British Friesian cattle are large in frame; they are of true milking type; and they possess the characteristics of dual-purpose cattle, rapidly putting on flesh when dry. The predominant colours are black and white, in about equal proportions. The colours must be very sharply defined, with very distinct patches. The head is long, and should be fine, with width between the eyes and at the muzzle. The horns are fine, curving inwards and keeping level with the poll: the neck is clean cut, fairly slender, but not too long: the chest is deep, with great thickness through the heart: the withers fine; the coupling long, and the belly low and exceptionally capacious, width and strength at the loins and a great spring of rib are essentials to allow for a tremendous barrel; the hind-quarters are broad, long and level, with greater width at the tail-head and through the thurls than in any other breed; the buttock is wide and flat; and the legs straight and strong.

Characteristics of the Breed.—*Milk Production.*—The outstanding recommendation of the breed is the extent to which the milk-producing properties have been and can be developed. Having been carefully and specially bred in Holland for centuries, the breed has the constitution to stand the strain of phenomenal production, the capacity to transmute large quantities of rough food into valuable merchandise and the ability to reproduce heavy yielders. The reports of the official milk-recording societies operating throughout the year under the control of the Ministry of Agriculture furnish ample proof of the value of the breed for milk yield. For two years in succession the Government's Annual Register of Dairy Cows has shown the eight heaviest yielders to be of the British Friesian breed, and in the matter of herd averages the breed has also led the way. Some idea of the progress made by this breed may be gathered from the fact that the first British cow to yield 2,000 gallons of milk in one year appeared early

Fig. 1.—Imported Friesian Bull

Fig. 2. Imported Friesian Cow.

in the year 1918, and the second late in 1919. At the time of writing the number of British cows with 2,000 gallon yields is 52, of which number all but 4 are British Friesians. The highest yield to date given by any pedigree cow is that of Kirkhill Flo 3rd, this cow having produced 2,602 gallons in 365 days, her butter fat percentage averaging 4.3 Such progress raises the hope that before long the production records of America and Canada, where at least 25 cows have yields better than 3,000 gallons in the year, may be reached. The best British Friesian production figures are the following :—

Kirkhill Flo 3rd	2,602	gal. in	365 days.
Colton Secret 3rd	2,524	„ „	365 „
Osmaston Jenny	2,427	„ „	365 „
Lothian Gladys	2,417	„ „	365 „
Eske Hetty	2,413	„ „	365 „
Brookside Colantha	2,368	„ „	365 „
Wiggington Geraldine	2,311	„ „	365 „
Kingswood Myrtle	2,283	„ „	335 „
Stanfield Dorrit	2,268	„ „	365 „
Southill Countess	2,245	„ „	365 „
Hedges (imported) Fronkje 3rd..	2,226	„ „	341 „
Duchess Wildrose	2,219	„ „	365 „
Beeeles Cynthia	2,216	„ „	365 „
Westwood Alexandra	2,207	„ „	365 „

At one time the opinion was held that any cow could only give such a phenomenal yield of milk on one occasion, and then only if she was kept free from the bull for many months, but experience is showing that both these ideas must be modified, as several cows have given 2,000 gallons twice in successive years, and others promise to do so and to calve again within the year.

Butter Production.—Attention must be called to the fact that five cows of the breed are calculated to have produced the equivalent of over 1,000 lb. of butter in one year. The following is a list of the breed's best butter producers :—

	lb.		lb.
Kirkhill Flo 3rd	1,316	Hedges (imported) Fronkje 3rd	942
Stanfield Dorrit	1,227	Kingswood Myrtle	940
Fillongley Abbotts Queen ...	1,093	Eske Hetty	936
Beeeles Cynthia	1,059	Hedges Moss Rose	931
Colton Secret 3rd	1,001	Blackmore Snowdrop 3rd ...	931

From the above it will be gathered how great are the possibilities of the breed for butter production, as the smaller daily percentage figure is more than counterbalanced by the

greater production of butter-fat consequent upon the greater yield.

Dual Purpose Value.—These cattle are large framed, and their ability to put on flesh, especially when dry, is a special recommendation, as more milk and no less beef in a herd find favour with the majority of farmers. Steers of the breed grow to a great weight and make first quality beef, and it may be mentioned that a pure bred steer was the Champion Farmers' Beast exhibited at the Norwich Fat Stock Show in 1921, and that a steer sent to the Smithfield Club Show, 1921, was the heaviest beast of its age on exhibition.

Herd Book.—Ten volumes of the Herd Book have now been published, the last containing entries of no less than 1,408 bulls and 3,599 heifers, all of which were born and registered for entry in 1920. A recent census taken by the breed society showed that the number of registered animals in the possession of Members of the Society in the United Kingdom approximated 20,000.

Prices Realised.—In the year 1921, 2,308 lots were sold at public auction for an average price of £124 2s. 9d., while in the previous year 2,088 lots realised an average price of £167 10s. 0d. The highest prices were obtained in 1919, when 1,893 lots were sold for an average price of £174 5s. 5d. In 1911, the highest price given for an animal at public auction was £53 11s. 0d., and in 1915, 340 lots were sold for an average of £39 5s. 2d. The present strength of the breed is indicated by these figures, although of course the value of all classes of stock has risen considerably since 1915.

Owing to the long interval between the closing of the ports to live Dutch cattle and the formation of a Society to establish a Herd Book, the characteristics of the breed were impaired to such an extent that fresh blood became necessary. This was obtained from Holland in 1914, the animals imported being highly successful in improving breed type, symmetry and quality—in fact, in making the modern British Friesian breed. Another consignment, this time from South Africa, was obtained in 1922, when the 83 imported lots sold at auction for an average price of £1,242 15s. 10d. These two importations would seem to be completely justified, in the first case by the successful results obtained in herds, and in the latter by the very high prices paid for the South African Frieslands.

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THE GRADING AND SIZING OF APPLES.

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Ministry of Agriculture and Fisheries.

WHATEVER opinion may be held as to the best package for marketing apples, it is generally agreed that better grading and packing are necessary. Good methods of packing have frequently been described, but little has been said about grading methods. Some confusion is caused because the word grading is used indiscriminately to mean sorting for quality or sorting for size. It would greatly simplify discussion if the latter were described as sizing and the use of the word grading were limited to grading for quality.

Grading (for Quality) must be done by eye, as, at present at any rate, no machine can tell the difference between green and red apples, or between clean and blemished fruit. There are two occasions on which it is convenient to grade—the first at the time of picking and the second at the time of packing—and advantage should be taken of both.

It is always good practice for a certain amount of grading to be done at the time of picking. Objection is taken to this on the ground that pickers are incapable of distinguishing between clean and blemished fruit. Such pickers should never be employed, as they will ruin the fruit in any case. It may not show for a few days perhaps, but the damage will be there. The pickers should collect only sound fruit reasonably free from blemishes. All seriously blemished fruit, jam apples, scrumps, and mummies should therefore be dropped on the ground near the foot of the tree. Care should be taken to see that the mummies are buried or burned. The others should be picked up and used or marketed as soon as possible.

When the crop is reasonably clean and is being marketed direct from the tree in wickers or half-barrels, it is usually graded and sized by hand by the packer, who places the fruit directly into the proper packages. When the bulk of the fruit is of one grade and size, the packer can run it through his hands into the baskets, picking out the other grades and sizes as he does so. When, however, there is a large bulk of two or more grades or sizes, it is better to run the fruit carefully on to a sorting table and pack from that. (A sorting table is simply a small table with a top of stout canvas instead of wood.)

When the fruit cannot be packed direct from the pickers' baskets, because it is being marketed in boxes, or has to go into store, or for any other reason, there are several appliances which may prove useful. Circumstances have forced the Western American growers to be pioneers in this respect, and it may prove of value to consider their practices. The remark is sometimes heard that just when the British grower is endeavouring to improve his standard, the American grower is slacking off—as evidenced by the shipments of the past season. That is, however, an entirely erroneous idea, which has arisen because the American used to send us his best grades, but now keeps them at home and sends us the inferior grades.

Estimates as to the extent to which different methods are in use appear in a recent publication of the U.S. Department of Agriculture.* These deal chiefly with central packing houses, that is packing houses which are operated either by the growers co-operatively or by individuals for profit. In passing, it may be observed that in 1916 it was estimated that a quarter of the crop was dealt with in such houses. In 1919 the proportion had risen to a half, and it is now probably still greater. This remarkable development gives considerable food for thought to the home grower, although it must be borne in mind that the circumstances in this country are not quite the same.

Methods of Grading and Sizing.—There are in common use three methods by which the fruit is graded and sized :—

(1) Entirely by hand.

(2) Mechanical aids to hand grading.

(3) Sizing machines.

(1) The first requires little capital outlay, and is favoured by the small grower, but experienced and careful packers are essential. The equipment consists of a canvas-topped packing table 26 in. wide and 30 in. high with division boards every 30 in. to separate the different grades. On one side is the sorting table, 20 in. by 30 in., and the packer's stand at the other side.

The fruit is poured carefully on to the sorting table, and the different grades (by quality, all sizes together), are picked out by hand and placed in their proper divisions on the packing table. The packer standing at the other side of the table sizes the fruit as he is packing it. If the crop is fairly clean one sorter can keep up with one packer, but if it is not, more sorters will be required than packers. When this method is adopted for packing into boxes, the packer will require a rest designed to hold three or four boxes, so as to clear up most of the sizes.

This is a very good method, but obviously the sorters and packers require considerable skill and experience.

(2) The chief mechanical aid in use in the Western States is the grading belt. This is simply a wide endless belt, which by means of revolving drums is kept moving over a table, with sides to prevent the fruit from rolling off. At intervals along the sides are narrow channels, one for each grade, leading to trays or bins for receiving the fruit. The ungraded fruit is poured on to a slightly sloping table at the end of the belt and passes on to it. The sorters stand by the side of the belt and grade the fruit (for quality only) as it is carried before them by deflecting the apples into the proper channels. The sizing and packing is done from the trays in the same manner as from the packing table described above. The use of this belt represents a considerable saving in time, but it is still necessary to have fairly skilled packers to do the sizing correctly.

(3) If sizing machines did what they ought to do, they would always be used, because unskilled workers can easily learn to pack accurately sized fruit. They usually suffer from serious defects, however, the chief of which are that they damage the apples and do not size the fruit accurately. Even in the North-Western States where grading and packing is almost an exact science, and these particular defects have been overcome, the perfect machine has not yet been placed on the market. The chief difficulty appears to be in apportioning the work between sorters and packers so that all are kept fully employed. In spite of these difficulties it is estimated that about half the crop is sized by machinery, and it is admitted that the result is more uniform and reliable. It is therefore evident that they are working on sound lines and a brief description of the machines they use may be of interest.

Sizing Machines.—There are only two patterns in general use and they both size by weight, the idea of sizing by diameter having been abandoned. It must be remembered that they have to deal with three grades (for quality) and 8 or more sizes of each grade. The smallest machine of the pattern in commonest use makes 8 sizes of one grade only and is 30 ft. long; the largest makes 48 sizes and grades and is 52 ft. long.

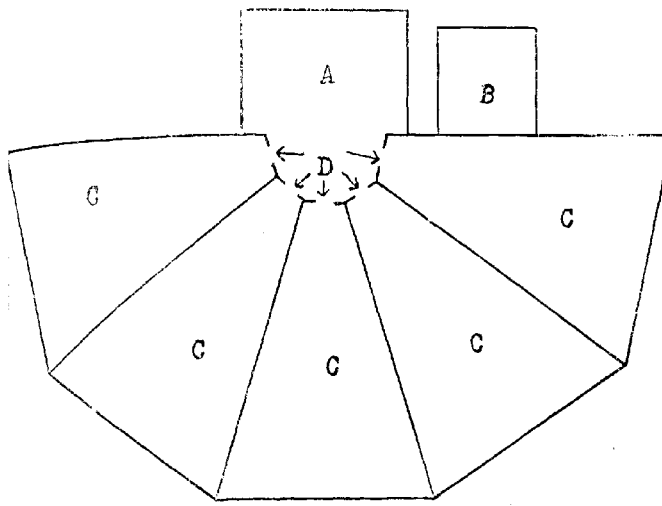
The fruit is fed on to a grading belt, similar to that already described, which carries it before the sorters. Another method is to have rollers, instead of the belt, arranged so as to turn the apples as they are carried forward. The sorters select the

fruit in three grades (for quality) and it then passes to the sizing part. The culls are dropped into a chute and arrangements are made to carry them away. In the sizing part there are three sets of carrying cups (one set for each grade) on endless chains. The apples are automatically fed into these cups one at a time, and are carried along. As they come opposite a tray they are balanced against an apple of the required size. If they are heavier they fall into that tray; if not, they pass on and are tried again at the next tray and so on. The packers then pack from the trays. A machine of this kind requires 20 workers—or more if the crop is poor—and the output varies from 600 to 1,000 boxes per day. Although the packers average perhaps 125 boxes a day, the average *per worker* for all operations is probably about 40 per day of 10 hours. The output depends partly on the quality of the crop, and partly, perhaps chiefly, on the efficiency of the management.

Another type of machine sizes the apples by throwing them through the air, the distance they travel depending on the weight. The apples go into the throwing cups one at a time and are caught in cloth catchers from which they roll into the bins. Now that growers are making a business of grading and packing, it will be necessary to give full consideration to the use of these and other labour saving appliances.

Suitable Method for England and Wales.—In considering the most suitable method for use in this country at the present time, particularly for small growers, it has to be borne in mind that grading for quality is not carried to such a fine point as it has to be in the Western States. There, three grades for quality are made, and the sorter has to consider not only blemishes, but must grade accurately for colour as well. Here less attention is paid to colour, though no doubt we shall do more in this direction later on; the main division is between blemished and unblemished fruit, and it is only the unblemished fruit that requires sizing. Moreover, we have few packers accustomed to select sizes accurately, and some guide in sizing would greatly assist the work, especially when packing in boxes. Various arrangements for dropping apples through holes of varying sizes have been tried, but it must be confessed that it is a somewhat tedious process.

A simple arrangement which would meet these requirements can be made by any grower on a plan such as is shown in the following diagram:—



A is a table on to which the ungraded fruit is poured, with sides 3 in. high to prevent it rolling off. B is a basket or box for receiving blemished fruit, and C are trays (sloping slightly away from A) for receiving the different sizes of unblemished fruit, and D are gaps in the front side of A of widths suitable for ganging the fruit to the different sizes required. The table and trays should be made of canvas on framework and the sizing gaps should be lined with felt. The sorter would stand behind the table A with the ungraded apples in front of him. He would sort the blemished apples into the box B and try the unblemished apples against the gaps D, allowing them to run through into the trays C when they would just go through. The packer would have a box on a rest at the further end of each tray. What promises to be a considerable improvement upon this method is being tried by officers of the Ministry and, if the results prove satisfactory, will be made public later. Some such arrangement would appear suitable for handling a small crop, but where packing on a large scale is to be undertaken, consideration should be given to the American machines.

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METEOROLOGY AND AGRICULTURE.

TOWARDS the close of 1920 the Agricultural Research Council appointed a Committee to consider the data now furnished by the Meteorological Office, to suggest what further data if any might seem desirable, and to make recommendations as to the fuller use of the information available in the development of agriculture and fisheries. The Committee's report, which has been adopted by the Council, is (with the exception of the sections relating to fisheries and international organisation of agricultural meteorology) summarised below.*

There are three ways in which the Meteorological Office assists agriculture, first by providing information as to prevailing or recently prevailing weather, secondly by issuing forecasts of weather to be expected, and thirdly, by research.

Forecasts and Reports for Farmers.—To the practical farmer the second of these methods of assistance is of most importance. Charts are drawn four times daily at intervals of about six hours, and issued with reports and forecasts. The 6 p.m. chart appears in next day's morning papers, while some of the evening papers publish a forecast for the following day based on the 1 p.m. chart. The Daily Weather Report, containing a copy of the 7 a.m. chart together with observations, and giving forecasts for the 24 hours beginning at 3 p.m., is issued at noon. Further, the Air Ministry issues by wireless twice daily, a general statement of the weather conditions and a forecast for the British Isles. In addition wireless reports giving weather observations made only one hour previously at 17 stations in the British Isles are sent out four times in the twenty-four hours in a code to which a key is published.†

Special agricultural forecasts are also issued by telegraph at a small charge. These include regular daily forecasts and notifications of expected spells of settled weather.

* The Constitution of the Committee was as follows: Sir Thomas Middleton, K.B.E., C.B., LL.D. (*Chairman*), Mr. J. O. Borley, Mr. R. A. Fisher, Mr. J. C. F. Fryer, Mr. R. H. Hooker, Prof. F. Keeble, Mr. H. G. Richardson, Sir Napier Shaw, Dr. G. C. Simpson; Mr. W. R. Black, *Secretary*. A copy of the full report can be obtained on application to the Secretary of the Meteorological Committee, Ministry of Agriculture, 4, Whitehall Place, S.W.1.

† A pamphlet giving detailed information regarding the use of these wireless messages for agricultural purposes may be obtained from the Air Ministry, Adastral House, Kingsway, London, W.C. 2, from whom information as to telegraphic forecasts may also be obtained.

Of the two remaining forms of assistance referred to above, the records given in the weekly and monthly weather reports, together with the summaries which appear in appendices, cover such data as temperature (at several stations, ground temperature and temperatures of the earth at depths of one and four feet are recorded), rainfall, sunshine and wind; and deviations from the normal are, where possible, noted. To the more scientific agriculturist who may wish to correlate some phenomenon in the growth or health of crops with weather conditions such information, together with the weekly, monthly and quarterly averages given in the Book of Normals, is of obvious value. The Book of Normals is issued in three sections; the fourth, not yet published, will give for selected stations the means and extremes of temperature in greater detail, and also the frequency of days of gale, frost, snow, snow-lying and hail.

The Meteorological Office has not hitherto been in a position to accomplish much direct research in agricultural meteorology. Sir Napier Shaw has, however, carried out several studies, which have been published in the Proceedings of the Royal Society, on the influence of rainfall on, and periodicity in, the yield of wheat, and the Computer's Handbook, issued by the Meteorological Office, contains in Section V, part 3, a number of summaries of papers dealing with the connection between weather and crops.

As regards the needs of the practical farmer the Committee is not of opinion that more could be done at present than is being done; there is no doubt that as and when the progress of science shall render it possible, the Meteorological Office will enlarge the assistance given.

Research.—The research worker is in a different category, and while it is scarcely to be expected that his specialised and detailed requirements could be anticipated by published records, every assistance possible, will, the Committee is assured, be afforded him by the Meteorological Office.

One special department of such research, to which the Committee gave special consideration, was that of plant pathology. Work already done points to a distinct relation between weather and insect and fungus pests. Potato Blight, for instance, and Corky Scab are associated with wet, mildews with dry summers. Unfortunately the biologists' records are as yet very inferior in statistical accuracy to those of the meteorologist. Until, therefore, a sound statistical method has been elaborated for recording

the incidence of plant pests, the existing data as to temperature, rainfall, sunshine and humidity are sufficient for all general needs.

The question of humidity (humidity of the air irrespective of rainfall), is, however, of importance, as there would appear to be no doubt that it has an important bearing on the growth of crops, on insect and fungus attacks and possibly, at times, on the health of live stock. Yet, in the absence at present of definite data, it is impossible to say what types of observations—relative or absolute humidity, dew-point, or readings of the wet-bulb thermometer—would be of most use to agriculturists.

Hourly values and normals for relative humidity are available at four Observatories, but at climatological stations readings are taken twice or at most three times daily, and normals are not issued by the Meteorological Office. Fluctuations in humidity are rapid, records would vary widely at different times of observation, and no satisfactory daily mean could be calculated. If, however, an agricultural investigator, desirous of obtaining humidity normals for any of the stations mentioned in Table IV of the monthly Weather Report, would specify the type of humidity required the Meteorological Office would endeavour to supply them. It may be pointed out that a supplement to the Daily Weather Report contains a useful table of the frequency of minima of surface humidity between fixed limits.

The Committee is of opinion that additional knowledge of the frequency of occurrence of humidity of different values is required; and recommends that special attention should be directed to this subject. Humidity records, unless they are continuous, would be of little use to the agriculturist; if, however, self-recording hygrometers were provided at stations for which records are required, and the total number of hours during which the humidity exceeded, or fell below, given percentages were recorded, the Committee thinks it likely that definite relationships between humidity and the growth and health of crops (or the incidence of diseases) could be established.

Hitherto, in this country, but little use has been made by agricultural science of the observations and records provided by the meteorologist. Abroad the position is different.

In the United States much attention has been given to a study of weather in relation to crops during the past ten or fifteen years. In Russia, before the war, an extensive series of agro-meteorological stations had been developed; while recently stations on the Russian plan have been established in Italy. The

lack of parallel work in our own country may partly be accounted for by the great expansion of studies in other subjects in the past twenty years.

These other studies have taken up the whole time of the investigators for whom provision has been made under the research and educational schemes hitherto adopted in this country. In part, too, the study of weather has received little attention from agriculturists because of the nature of our special problems.

In our insular climate the influence of weather is less sharply defined than in continental areas; and relationships there obvious enough, are here apt to be overlooked. Ideal seasons for wheat, for example, might be indicated in the Middle West of North America or in Russia; but here we find the crop sometimes equally well suited by very different types of weather.

Suggestions for Further Investigations.—Although the general character of our climate may free our harvests from catastrophes, except at long intervals of time, and the fickleness of our weather may make the interpretation of its effects on our crops an elusive study, agriculturists cannot afford to continue to neglect the opportunity for investigation which advances in meteorology have placed at their disposal, and the Committee is of opinion that studies of the folowing three types should now be encouraged.

(*a*) Studies of the relationship between weather and harvests in various districts on similar lines to those followed by Mr. R. H. Hooker.* Such studies, for which much material already exists in weather and crop reports, might lead to the discovery of correlations sufficiently well marked to be of practical assistance in forecasting future yields.

(*b*) As a necessary preliminary to such studies, more complete records will be required as to the state of crops in different districts at different stages of their growth, with special reference to the effect of weather.

It is suggested that observations should be made at specified experimental stations and that the Ministry should arrange for the collation and preservation of these "crop-weather" records.

(*c*) If in future we are able to draw conclusions respecting the yield in particular seasons from the weather records, we must have much more precise information as to what constitutes an optimum sequence of each element of weather for a particular crop and locality.

At present we use accumulated temperature over 42° F. as an index of conditions favourable to vegetation; but accumulated temperature by itself is not enough. American studies have

* The Correlation of the Weather and Crops. Jour. Roy. Stat. Soc. Vol. LXX. Pt. 1., Mar. 1907.

shown how very rapidly the rate of growth of maize falls off above a certain temperature. Until we have similar information for such crops as the oat and the swede, which are often injured by heat, we are not able to interpret the effects of temperature records.

It is the same with rainfall. In certain parts of the country the average weekly rainfall is believed to be near an optimum for oats, but it is not known exactly how near in any particular locality. In East Anglia, for instance, as Mr. Hooker has shown, the spring rainfall is below the optimum, so that there is a marked positive correlation between rainfall and yield from the 13th to the 28th week in each year. No similar correlation has been found in Scotland, presumably because there the average rainfall is near the optimum.

There is need of a study of the requirements of various crops as regards water, temperature and sunshine. Such study must include comparative investigation of soils. It is not enough to ascertain the quantity of water which a plant will require in the normal temperature and sunshine of a given district; we must also know what quantity of water typical soils, differently cultivated, can provide. Such information has hitherto only been available from the Rothamsted drain gauges; now that these have also been installed in Aberdeen data from a new district will be available.

The Committee is convinced that a scheme of observations and records, such as is outlined above, would greatly increase the general interest in the question. For practical farmers it would have an effect comparable to that of a sound system of book-keeping on the financial side of their calling—the effect of co-ordinating and articulating the very considerable fund of knowledge of weather and crops, which, though vaguely and almost unconsciously, is already theirs.

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TRIALS OF NEW VARIETIES OF CEREALS.

PART II.

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PART I of this Paper dealt with the subject of variety testing in general and the present part deals with a method designed to reduce the probable error of the results of trials of new races.

"**Half-Drill-Strip" Method.**—Every new race under test is separately compared either with an established "standard" race, or with a local race of the same cereal, or with both, hereinafter in either case called the "control." The seed used for all the plots at any station should have been grown and harvested under equal conditions.

The new race and a control race are each grown on ten or more alternating strips of about 1/20th acre per strip—as shown below—where "A" represents the new race and "C" the control.

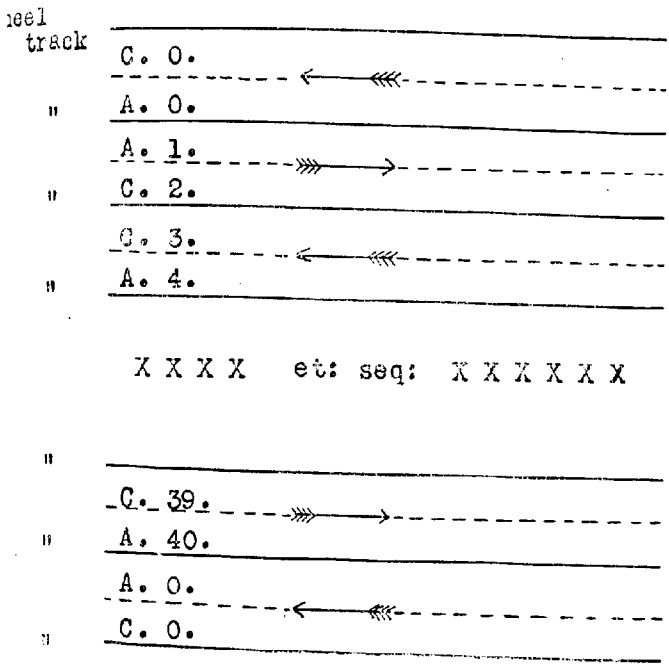

FIG. 1.—Showing Half-drill Strips.

Drilling.—The width of each "variety strip" will be that of the drill employed for seeding. If, as is generally the case with corn-drills, the coulters are an odd number (either 13 or 15 at 7 to 8 in. apart), the centre coulter is put out of action, as is easily done with any make of corn-drill. In the centre of the seed-box a partition is placed: most corn-drills are constructed with a centre partition. One compartment of the seed-box is filled with seed of the control and the other with seed of the new race.

The effect is that after each " turn " of the drill, two half-drill-strips of the same race are seeded alongside, so that when the drill has made 21 " turns " there are 10 drill-wide-strips (20 half-drill-strips) of each race and two half-drill-strips—one at each end of the series. The produce of the two half-drill-strips first drilled at the edge of the field is excluded from the experiment and therefore the weighed produce will be that of 20 half-drill-strips or half an acre of each race. If the series consists of only one race and a control, it will be best to drill 22 drill-strips and exclude one full drill-strip (two half-drill-strips) at each end of the series.

It is necessary that the coulters of the drill should be at precisely equal distances apart, except the two on either side of the centre, where, in the case of a drill with an odd number, one has been put out of action. It is necessary, therefore, to use a drill in which the distances apart of the coulters are adjustable. It is convenient to have something more than a row-space along the lines separating the two races, *i.e.*, in the centre of the drill, but it is imperative that the " over-all " width of the two half-drill-strips should be precisely equal, so that each race gets an equal area. It is also very necessary that all the coulters should deliver the seed at equal depths. The two halves of the drill should in fact be alike in all respects.

The drill should be fitted with a good steerage and the first " turn " should be driven on a marked out line. At each successive turn it should be so driven as to give a uniform space in the line of the wheel-tracks which will be the centre line of each variety strip, dividing each such strip into two equal half-drill-strips. This space should be equal to that in the centre of the drill separating the two races. The effect will be to give each half-drill-strip an equal area with something more than a row-space in the centre of each variety strip, and a similar space between each variety strip: all the spaces being uniform in width. This arrangement is necessary in order to facilitate separation of the races at harvest.

The diagram below shows that with a 13-coulter drill using 12 coulters 7 in. apart, and with 12-in. spaces between the half-drill-strips, the width actually seeded including spaces is 47 in. for each half-drill-strip. The length required to give 1/40 acre per half-drill-strip is therefore in this case 278 ft. If less or more coulters are used the length will be correspondingly altered.

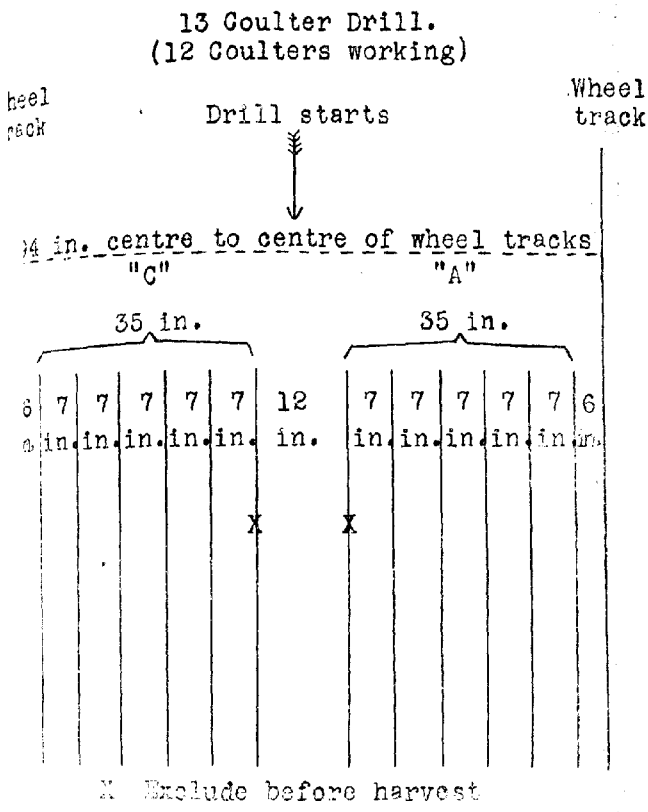

FIG. 2.—Diagram showing Row-spaces.

The above is the length of the strips to be harvested. The lengths to be drilled should be about 9 ft. more, because it is not possible to start and stop the drill exactly on a line, and also the ends must be trimmed to a straight line across the strips before harvest. Obviously, the precise areas seeded are not important provided they are equal and accurately measured. The produce can then be corrected to yields per acre after threshing.

Where the shape of the field is such that strips of twice the above length are more convenient, half the above number of strips of each race may be sown. In this case the length should be somewhat more than doubled and a space of about 10 ft. cut out across the middle of the strips in order to make two sets of 10 half-drill-strips of each race. The full length to

be drilled allowing for this space and for trimming the ends will be about 580 ft. in the case of a 13-coulter drill with 12 coulters working.

Where, as is frequently the case, it is found impossible to avoid placing the trial on land which has been differently cropped or manured in previous years, the strips should, if possible, cross the lines marking the different soil conditions rather than run parallel with them. If possible, the longitudinal direction of the strips should be north and south, or as nearly so as the shape of the field admits.

It will be noted that one acre is required for each race when only one control is used, and two acres for each race when two controls are used, because in the case of two control races the experiment is duplicated in every respect by the addition of the second control race.

Drilling will be found to be much less complicated than would appear from the above directions. Once the drill has been adjusted this goes forward as rapidly as with ordinary drilling. It is quite possible to drill 6 or 8 acres, viz., 6 or 8 separate yield trials in one day if the drill is made ready the day before and if the superintendent is familiar with the method, and has two or three intelligent helpers, one of whom must be an expert drillsman. A good deal of time is occupied in cleaning out the drill (or half the drill where the same control is used for several new races), but no more than when single half-acre plots of each race are drilled. The cleaning out is much more easily done with a drill of the Massey-Harris forced-feed type than with a cup-drill, but a " steerage " is very necessary.

Cutting.—The method to be followed in cutting and in the subsequent operations will depend partly on the state of the crops at harvest time and partly on the degree of accuracy which is aimed at.

A source of systematic error is introduced in all strip methods of comparison if there is " interference " of one race with another along the lines of separation.

In the Warminster trials of 1920 and 1921 the two races compared were of very similar habit of growth—so much so as to be almost indistinguishable at all stages, and it was obvious that there was no interference of one race with the other. The whole of the area drilled, excluding the first and last strip, was therefore harvested and weighed.

In other cases, however, interference will often arise either

from one race overtopping the other; or from lodging across the strips; or from a more active root-system of one race than of the other causing more vigorous growth of that race along each line of division.

It will generally be necessary to make sure of eliminating this possible systematic error. This can be done by cutting out before harvest one row of each race along the lines of separation. This will reduce the number of rows in each half-drill-strip and involve either an addition to the length of the strips or a correction of the figures to give yield per acre. The method of calculating the probable error of the experiment will not be affected. The additional labour will be fairly considerable, but the work can be done well before harvest and will facilitate cutting and harvesting.

If the two races ripen so nearly together that they may be cut on the same day, and if there is not much lodging, the cutting can be done with a " side-delivery reaper " or with a " self-binder " fitted with an adjustment to be referred to later.

If the difference in time of ripening is only a few days, the early ripening race may be left standing till the later is ready for cutting, and in the case of barley this will generally be possible. If, however, the difference is so great that there would be any risk of " shattering " of the grain of the earlier race, the strips must be cut by hand; also, obviously, if there is severe lodging hand-cutting is the only feasible plan. If the lodging is across the plots it may be necessary to go down the spaces between the half-drill-widths with a stave and throw back on either side the produce of each strip in order to make a clean separation immediately before cutting.

The writer's experience of the method has been only with barley and although the straw was very heavy in both 1920 and 1921 in neither year was there any difficulty in cutting with a " side-delivery " reaper. It is, no doubt, more likely to be necessary to cut by hand in the case of oats than of either wheat or barley.

When the plots can be cut with a reaper or binder, if the drilling has been fairly straight, there will be no difficulty in driving the machine so as to cut each half-drill-strip separately. This is facilitated if a man walks behind the machine and warns the driver quickly if he is going astray. The driver should in any case avoid cutting into the next half strip, and if a few plants are left uncut these can be cut by hand and

added to the nearest sheaf before the machine comes round again. It will generally be best to cut only one way of the field for a reason which will appear later.

Binding.—Whether the plots are cut by hand or by a reaper or by a self-binder, the sheaves of the two races must be kept rigidly distinct. The best plan is to use string of two different colours. If a binder is used, a loop of coloured string should be attached to each sheaf of one of the races, before the next turn of the binder.

Field Weighing.—In 1920 and 1921 at Warminster the half-drill-strips of the two races under comparison were cut with a side-delivery reaper—each half-drill-strip separately—and in order to leave approximately the same amount of stubble on all the plots, so that the straw-weights as well as the grain-weights might be comparable, the strips were only cut in one direction.

Machines of this type (now generally superseded by self-binders) have an advantage for this particular purpose:—They throw off two sheaves for each revolution of the rakes, and as the rakes are driven by the travelling wheel each two following sheaves represent the produce of equal areas. In 1921 the area corresponding to each two sheaves was within a negligible fraction equal to 1/500 acre. In this case, therefore, the effect was to split each of the two half-acres into about 250 plots of equal size, and, obviously, it would be possible in such a case to repeat Hall and Mercer's Rothamsted experiment and obtain not only the total weight of both grain and straw on the two half-acres, but also it would be possible to obtain the weight of grain and straw on each 1/500 acre and by this means reduce the probable error of the comparison in respect of both grain and straw to probably a fraction of 1 per cent. This would, however, entail so much labour and supervision as to be practically impossible for a series of plots, and, moreover, would be a "work of supererogation." What was done at Warminster and what is practical was as follows:—As soon as the sheaves had been tied with red and plain string respectively each sheaf was weighed. This was done on a Salter's spring balance graduated to single ounces up to 20 pounds. A balance reading to tenths of pounds would be preferable in order to give a more simple record for statistical purposes. The balance may be suspended from a pole about 6 ft. long carried on the shoulders of two men, and the sheaves weighed two at a time in the order in which they are thrown off by the

machine. The balance should be fitted with a cradle on which the sheaves are placed. The weighing of 500 pairs of sheaves may be performed in about three hours by one assistant reading the weights; one entering them in a prepared book; a man lifting the sheaves on and off the scale; and two men carrying the balance. This operation is therefore feasible for a series of variety trials.

A comparatively simple attachment has been devised for a self-binder in order to deliver sheaves corresponding to equal areas, instead of sheaves of approximately equal weights which is the present arrangement in all self-binders.

If the strips have to be cut by hand, each half-drill-strip may, obviously, with little difficulty be divided into a number of equal plots, and the sheaves on each plot weighed.

The only practical method of collecting the produce is to bulk all the " C " sheaves into one small stack and all the " A " sheaves into another; to thresh the stacks and weigh and record the grain and straw threshed from each stack.

These figures for the total weights of grain and straw on half an acre of each race obviously give no indication of the probable error which attaches to them in the absence of any weighings of the produce of smaller areas, but a very close approximation to the probable error of these weights can be arrived at by a statistical treatment of the sheaf-weights.

It has been found in repeated experiments that the ratio of grain to straw is constant within very narrow limits for the same race when grown under the conditions above described. It may therefore be safely assumed that the probable error of the total grain-weights of each race is not appreciably greater than that of the average total produce on a large number of small areas of each race.

From the tabulation of results in a very large number of similar cases the writer finds that the probable error of the weight of grain is, in fact, less than that of the corresponding weights of grain plus straw.

The object of the half-drill-strip method is to minimise the effect of divergencies in the conditions external to the plant, and there is no doubt whatever that this result is obtained. If the sheaf-weights are determined either for small areas like 1/500 acre by weighing pairs of sheaves, or even only for 1/40 acre half-drill-strips of each race, then the results can be stated in terms of (1) weight per acre of grain, (2) weight per acre of straw, (3) weight per acre of total produce, and (4) probable

error of the weight of the total produce as weighed in the field, and these figures will obviously be much more reliable than a mere statement of the weights of grain and straw on single plots without any indication of the probable error of the comparisons.

The results which have been obtained indicate that, by the half-drill-strip method, the probable error of the difference between the weights of grain of the two races may be reduced to about one-half of one per cent. as against something over five per cent. when single plots are compared.

It is hardly necessary to add that the operations of drilling, cutting, binding, sheaf-weighing, harvesting, threshing and ultimate weighing of grain and straw require a very different type of supervision from that of ordinary agricultural operations and even from that required in field trials as they have usually been conducted, and also involve considerable extra cost.

(As an example of the results obtained by the method described above, the author has prepared a supplement to this article containing tables, with notes, showing in detail the results of an experiment at Warminster in 1921 in which a new race of barley was tested against a control race. The probable error of the results is discussed and their reliability compared with that of a trial with two single half-acre plots of two races. Any reader who is interested may obtain a copy of this supplement, post free, on application to the Ministry).

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WEATHER FORECASTS BY WIRELESS TELEPHONE.

THE following question was asked in the House of Commons on 28th June last:—

Mr. L. Malone asked the Minister of Agriculture whether he is aware of the extent to which wireless telephony is being utilised in France to assist agriculture by broadcasting a weather bulletin twice daily from the national meteorological office; and whether any similar schemes are in contemplation for this country?

Captain GUEST (Air Ministry) replied as follows:—"I have been asked to answer this question. Pending the result of inquiries which are being made, I have no information, other than that which has appeared in the Press, as to the French arrangements for issuing weather forecasts to agriculturists by wireless telephony. The feasibility of using wireless telephony for this purpose in this country is at present under considera-

tion. I may say, however, that the Air Ministry issues daily by means of wireless telegraphy a number of weather reports which could be of considerable use to agriculturists, and with a view to meeting the case of agriculturists and others possessing, or about to instal wireless receiving apparatus, a pamphlet giving particulars regarding these messages and instructions as to their reception and utilisation has been prepared and will be issued in the course of a few days. In addition, the pre-War arrangement by which afternoon forecasts were issued during the harvest season was extended two years ago, so as to enable a farmer, on payment of the cost of telegraphing, to obtain a special forecast at any time which suited his individual need."

The *Journal Officiel* for the 29th June, 1922, contains a description of the system of distribution of weather forecasts by wireless telephone which is now being started in France. Three times daily the Eiffel Tower broadcasting station in Paris will send out a forecast of the weather for the same day and the next day. Communes (roughly corresponding to urban or rural districts in this country) may instal at the public cost a receiving apparatus in a school, police station or at the home of some chosen person, and the messages, which will be received at fixed hours each day, will be communicated in the district by the ringing of a bell—no ringing if there is no change of weather, three strokes to announce rain, six to announce frost, ten to announce storms or hail. The messages can be received by an extremely simple apparatus, the cost of which, including installation, is not expected to exceed 200 francs (about £4 at the present rate of exchange) and the French Meteorological Office has prepared a pamphlet for those who wish to make the apparatus themselves.

Arrangements were made for the distribution of the forecasts to begin on the 15th July. The messages will at present be received only within a distance of about 310 miles from Paris, but arrangements are being considered for distributing the forecasts in the rest of the country by means of district stations.

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REDUCTIONS IN RAILWAY FREIGHT CHARGES.

THE Railway Clearing House has issued a circular, dated 12th July, indicating the reductions in Railway Rates for Traffic conveyed by merchandise trains, which become operative on and from 1st August, 1922. The following extract from

the circular shows the nature and extent of the reductions affecting agricultural traffic :—

Description of Merchandise, etc.	*Rates to be charged.* The rates in operation on 14th January, 1920 (except rates operating for specific periods, which periods have expired since 14th January, 1920, or rates which are in force under terms of special agreements), with the undermentioned additions thereto.
1. Coal, Coke and Patent Fuel.	Percentage increase to be further reduced from 75 per cent. to 60 per cent. Flat rate to be further reduced from 3d. per ton to 2d. per ton. Maximum addition to remain at 3s. 6d. per ton. (3s. per ton where now applicable to be retained.)
3. Manure, packed, and lime, packed, in Class C, in loads of 2 tons and upwards, when for use as Agricultural Manure in England and Wales and so consigned.	Percentage increase to remain at 50 per cent. Flat rate to be reduced from 9d. per ton to 4d. per ton.
5. Traffic in Class C of the General Railway Classification other than above.	Percentage increase to be reduced from 100 per cent. to 75 per cent. Flat rate to be reduced from 9d. per ton to 4d. per ton.
6. Traffic in Classes 1 to 5 of the General Railway Classification.	Percentage increase to be reduced from 100 per cent. to 75 per cent. Flat rate to be reduced from 1s. per ton to 6d. per ton.
8. Live Stock at Truck Rates.	Percentage increase to be reduced from 100 per cent. to 75 per cent. Flat rate to be reduced from 2s. per truck or part truck to 1s. per truck or part truck, irrespective of distance.
9. Live Stock at Head Rates.	Percentage increase to be reduced from 100 per cent. to 75 per cent.
10. Small Parcels (as defined in Part VI. of the Railway Rates and Charges Orders).	Percentage increase to be reduced from 150 per cent. to 100 per cent.
11. Returned empties.	Percentage increase to be reduced from 100 per cent. to 75 per cent.

LABOUR ORGANIZATION ON AN EAST MIDLANDS FARM.

PART II.

ARCHIBALD BRIDGES, B.A.

The Crop Rotation and the Distribution of Labour.—The study of labour organization on the farm would not be complete without a consideration of the distribution of the labour on the crops. The graphs Figs. 1 and 2 will have conveyed the essential requirements in the organization of labour on the whole farm, especially in the relation of stock to arable and the part which "granary" and "establishment" work play in this organization.

Fig. 3 shows the distribution of the manual and horse labour on the arable land for the 1918 crops, with the addition of the work necessary on the twenty-two acres of meadow hay. All work performed from the beginning of cultivation of each crop until it was cleared off the ground is shown. It should be noted that in the case of mangolds no work appears after clamping. The subsequent work of cleaning and carting is considered to be a charge to the stock and is included in the work shown for the sheep and other stock in the previous graphs. The same remarks apply to the turnip crop, but in this case they were mostly eaten off on the ground by sheep, and very little carting work was necessary.

Stress has already been laid on the necessity of the work for live-stock dovetailing with the labour for the cropping system on the farm. Consequently the latter should be arranged, as far as possible, so that each crop in the rotation requires its labour at a different time in order to equalize labour demands and keep the men and horses fully employed. An examination of the principal crops on this farm—winter wheat, barley, turnips and swedes, mangolds, and the mowing and grazing seeds—will show that they largely fulfil the condition laid down as regards labour distribution. The wheat is making its maximum demands in the months of September, October and November, and then requires little attention until the next harvest in August and September. Barley is making its maximum demands in December, January, February, March and April, and again very little further demand until harvest. The root crops are making their principal demands in May, June and July when very little can

be done on the grain crops, and again in November the mangolds are harvested when the principal work on the winter grain crops is over. Mowing seeds only come into prominence at hay time in July, and the grazing seeds require so little labour as to be hardly worth consideration. The whole year, therefore, is provided for with a succession of crops requiring their maximum attention at different periods, such crops being said to be complementary to each other. It is true that the graphs show the complementary crops competing extensively for labour at harvest time, but it is probable that if a weekly chart had been drawn up it would have shown that the harvesting of one crop followed another in close succession and that they were therefore complementary even at this period. The four-course rotation, which has been used here to illustrate the principle of complementary crops, is thus shown to rest on a solid economic basis as far as labour distribution is concerned.

The next point of note in the graphs is that certain crops are demanding attention at the same time, or within a comparatively short period of time. The three spring crops, barley, wheat and oats will serve as an illustration. According to the graph spring wheat made its maximum demands in December and March: spring oats in March and April, in which months also the preparation for and sowing of the barley crop was important. During the succeeding months until harvest, they were more or less demanding attention at the same time. Crops of this nature are said to be competitive. The farmer has a choice, and in selecting from such crops, he should sow that one which adds most to his net profit, a point which he will be able to gauge from experience and the relative yields and prices in the past. Crops competing for labour with the winter wheat are beans and winter oats, and a qualification of the rule as to competitive crops should here be stated. The part which a certain crop plays in the other enterprises of the farm should receive attention. Oats are commonly grown as a food for horses, and beans are a first rate foodstuff for all classes of farm stock. Again the suitability and condition of the land at the time for a particular crop should be considered.

In building up a rotation of crops from the labour point of view, with a given area of land and a given supply of capital equipment, the principle, therefore, should be to make the crops as far as possible complementary to one another, choosing such crops as give the maximum profit, and at the same time

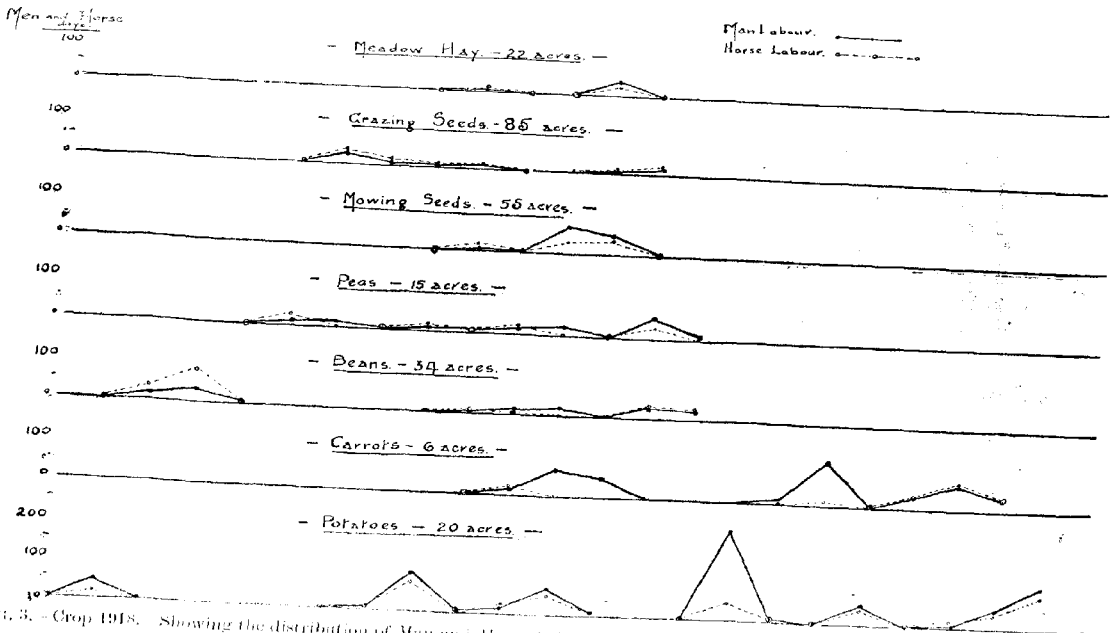
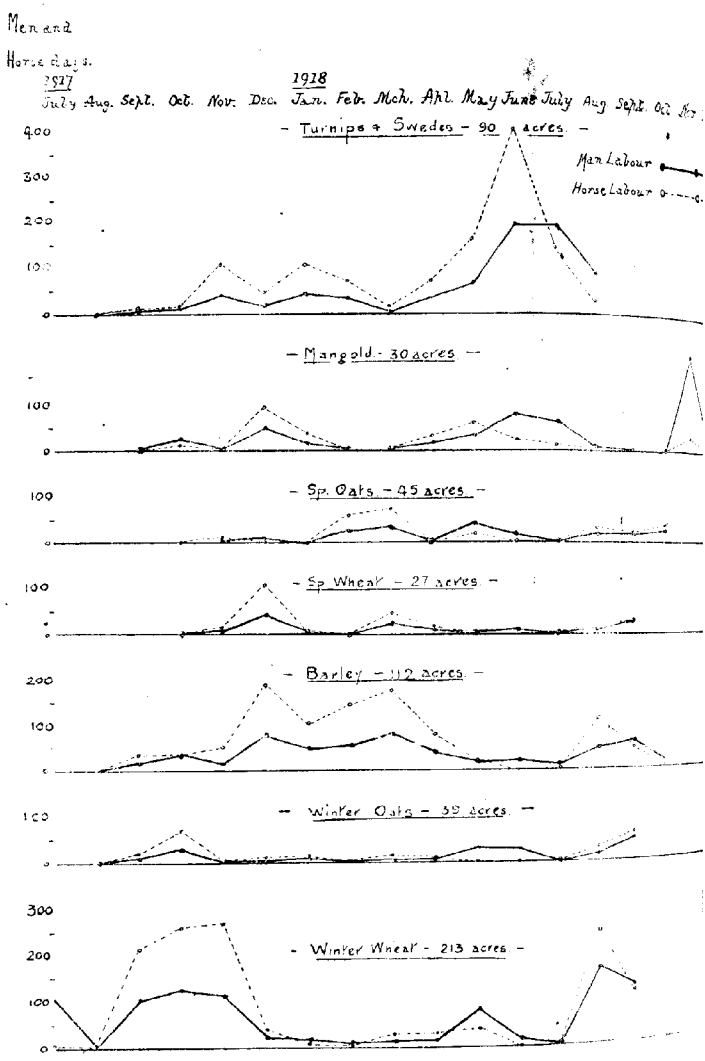


FIG. 3. — Crop 1918. Showing the distribution of Man and Horse Labour, and the competitive and complementary nature of the crops. (Continued on next page.)



Continuation of Fig. 3.

having regard to the other lines of production on the farm which make demands for home-grown produce.

The relative importance of men and horses at different stages of growth should be carefully observed. In the case of the grain crops, the proportion of horses to men is greatest at the time of ploughing and the preparation of the land for the sowing of the corn, where the ratio is approximately two horses to one man. The opposite condition of affairs is seen in May and June when manual labour is of importance.

Another point to note is that certain crops have responded to the use of equipment involving a relatively large use of horse labour to manual labour, while others again require mostly manual labour. In the case of the carrot and potato crops the manual labour line is either above the horse labour line, or is closely associated with it, for the greater period of the growth of the crop. This point will be discussed later. These two crops were distinctly competitive in their nature. Casual labour was necessary for the planting and harvesting of the potatoes, and also for the weeding and thinning of the carrots, a very expensive item. On the other hand, the large amount of productive work which these crops required for their disposal during the winter months, when other work on the land was distinctly slack, compensated to a large extent for the competitive period. It must be remembered, too, that the land is very suitable for the growth of these crops, and naturally this is a large factor in their introduction into the crop rotation.

The pea crop never occupied a large acreage in the rotation, and as the distribution of labour was extremely regular throughout its growth, it did not disturb labour requirements to any extent. The justification of diversity of cropping can also be advanced in its favour. The crop was usually sold off the farm.

Relative Labour Demands of the Various Crops.—It is well known that crops vary considerably in the amount of manual and horse labour they require. The following table compiled from the sum of the monthly totals in the graphs showing the distribution of manual and horse labour and reduced to a single acreage basis for comparison demonstrates this fact. Before discussing this table it should be noted that the figures relating to the grain and pulse crops are up to the point of harvesting only. They are therefore exclusive of the necessary

LABOUR EMPLOYED IN TERMS OF MEN AND HORSE DAYS PER ACRE FOR THE 1918 CROPS.

Crop.	*Acreage.*	*Days per acre.*	
		Men.	*Horses.*
(*a*) *Arable*—			
Winter Wheat	213	4·35	6·22
Spring Wheat	27	4·08	8·04
Barley	112	4·63	8·73
Winter Oats	39	5·08	6·04
Spring Oats	45	3·71	5·41
Turnips and Swedes	90	8·31	13·56
Mangolds	30	16·73	10·10
Potatoes	20	33·80	19·05
Carrots	6	61·42	26·50
Beans	34	4·00	5·65
Peas	15	7·73	5·60
Mowing Seeds	55	2·18	1·31
Grazing Seeds	85	0·71	1·02
	771		
(*b*) *Pasture*—			
Mowing Grass	22	2·09	1·41
Grazing	172	0·09	0·08
	194		
	965		

(*In the case of the grain and pulse crops the figures shown are exclusive of threshing, dressing and delivery.*)

work for threshing, delivery, &c. Figures were available showing the whole of the threshing and granary work, but unfortunately they were not sufficiently detailed to make a fair distribution to the crops concerned. Steam cultivation work was carried out on seventy acres of winter wheat, thirty-eight acres of spring oats, and twenty-two acres of barley.

The intention here is not to give average figures but to show the extraordinary difference in the amount of labour necessary for each crop. If we take four men-days and six horse-days as the ordinary requirements of an acre of the grain crops up to the end of harvesting and two men-days and one horse-day are added for the subsequent work of threshing, dressing and delivery, making a total of six men and seven horse-days, it will be seen that, approximately, the mangold crop takes two and a half times, potatoes five and a half times, and carrots ten times as much manual labour as the grain crops, and with regard to the horse labour the ratios are approximately $1\frac{1}{2}$, 3 and 4 for the same

crops. The greater bulk of the root crops and their greater manurial requirements, partly explain the large demands which these crops make. The other reason is that they have not yet largely responded to the use of implements. In some crops the manual labour demands are low with relatively large requirements for horse labour. Grain and beans are examples. These are crops for which implements and machinery are largely used, thus greatly reducing the manual labour required in handling them. The opposite condition of things is seen in most of the other crops—the men are relatively more important than the horses—showing that implements and machinery have not yet been devised seriously to reduce the use of manual labour. These facts are well known to farmers, but their general importance in governing the area under any type of crop is not so well realised.

It is easy to handle large areas of crops which are worked by implements, and within limits the area can be increased without largely disturbing the labour requirements. This is well illustrated in prairie farming where manual labour is scarce and dear, and the only crops grown are consequently those on which machinery can be used. On the other hand, with crops needing much manual labour per acre, the area must necessarily be limited, and cannot be increased to any extent unless a much larger supply of labour is obtainable. The question of seasonal distribution has also to be considered, *e.g.*, in the case of potatoes the planting and lifting periods mostly require a supply of labour outside the ordinary resources of the farm.

The question of management must also be thought of. It takes comparatively little effort to direct operations on crops where the manual labour requirements are small, but a much higher standard of efficiency in management is essential for a similar area under the potato or other crop where a large number of labourers must be directed and controlled in their work.

Alternatively, the influence of such crops as the rotation grasses and grazing in reducing the demand for labour should be observed. The total requirements of these crops are very small compared with the other crops on the farm. The greatest reduction will be possible when the land is laid down to grass and grazed only. Seeds hay and meadow hay require an appreciable amount of labour, as the table shows. Where temporary leys are put down the labour demands will depend on the time the land is left down. If the four-course shift is

followed, one-quarter will be in rotation grasses or clovers and three-quarters under the plough. If the ley is left down for two years then the course becomes a five-course shift, and the proportion under grasses is two-fifths and under the plough three-fifths, and, if kept down a third year, then one-half is under grasses and the other half under the plough. Of course the increased stocking capacity of the farm with a greater area under rotation grasses will counteract the tendency to reduce labour requirements, but an acre under grass together with the stock it will carry, should not, unless dairy farming is being carried out, require so much labour as an acre under the plough.

The greatest economy in laying down to grass or having a larger area under ley will probably lie in the horse-labour. The horse-labour requirements are extremely low in comparison with all the other crops, and as stock generally make little demand for horse labour the increased stocking necessary for a larger area of permanent grass er ley would hardly have any influence on the horse-labour requirements.

Labour Requirements of Different Farms.—*Manual Labour.*—It will be evident from the figures supplied in the last table that large variations must occur in the labour requirements of farms. At one end of the scale we have market-gardens employing 12 to 20 persons per 100 acres in the cultivation of small crops with high labour requirements, and at the other end the grazing of sheep where the manual labour falls below 1 person per 100 acres. Between these two cases large variations arise, and to determine with any degree of accuracy the number of hands required on any given farm is one of the most difficult problems of farm management. The land and stock managing capacity of the labourer varies with the size and type of the farm, with the fertility of the soil, the method of cropping adopted and the type of stock carried. It varies also with the implements and machinery at the disposal of the labourer, these to a certain extent determining his efficiency, and this again is closely bound up with the managerial ability of the farmer himself and the capital at his command.

It is probably true that on arable farms, or farms mainly arable, the size of the farm will be the chief factor in determining the land and stock managing capacity of the labourer. As the size of the farm increases implements and machinery can be more extensively and economically used, and the manual labour requirements are therefore smaller in proportion as the size

increases. Here, however, a limit is set, for it would appear that when the size is such as to be unwieldy, having regard to the capacity of the individual farmer, his efficiency as manager may be reduced and the manual labour requirements become stationary or may even rise.

On the other types of farms—dairy, cattle-rearing, cattle-feeding, and mixed farms—the problem is more difficult. It would seem that the fertility of the soil which determines the stock-carrying capacity of the farm will be the limiting factor in labour requirements, but in the absence of sufficient data definite pronouncements cannot be made.

It is true that the larger the farm the greater the tendency to have specialised departments with workers more or less skilled, but here again the departments are never clear cut. If we refer to Fig. 1* it is easy to see that men are shifted from one department to another as required. In the case of sheep a full-time shepherd was employed, but there were very few months in the year in which he alone was able to overtake the work. The demand for labour from October onwards, when the sheep were on roots, was doubled, with a still greater demand at lambing time in March. Even in the early summer when the shepherd did the bulk of the work himself, additional assistance was necessary for washing, shearing and dipping. Similarly with the other stock of the farm. During the summer and autumn when the stock are on grass the labour requirements are at a minimum—an average of little over the time of two men being required during this period. Immediately the stock are brought into the yards and the cows housed for the winter the labour requirements rise at once, falling again as soon as the condition of the weather improves and the growth of grass suffices to maintain the stock out of doors.

What in fact happens on the larger farms is that a skeleton organization of skilled workers in each department is obtained. Outside these a number of general labourers are necessary who may be transferred from one department to another as occasion requires. On the smaller farms the employed man must necessarily be an all-round man.

Horse Labour.—With regard to horse labour the position is more clearly defined. On each type of farm the demand varies considerably, but within each, size is the determining factor in horse labour requirements. The demand per acre varies in inverse proportion to the size of the farm.

* See this *Journal*, July, 1922, p. 322.

The illustrations and principles discussed above demonstrate why proposals for radical changes in agricultural methods are slow to take hold. The principal point to remember in labour organisation is to preserve a proper balance as between the crops and pasture and the stock. Ploughing-up of pasture, or alternatively laying down land to grass, increasing the areas under certain crops, and reducing or increasing the stock, have all to be carefully considered not only in themselves but also in relation to the farm as a whole, and to the capital, equipment, and labour supply at the farmer's disposal.

Good wages are necessary to attract and retain good labour, but good wages can only be paid if the farmer can organize and direct it well, and at times when the margin of profit on farming capital cannot be great, even under the best conditions, success is dependent more upon the farmer's capacity as an organizer of labour than on his standard of knowledge of agricultural science and farming technique.

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COBBETT ON THE CROPS.

SIR HENRY REW, K.C.B.

ABOUT midsummer, a hundred years ago, William Cobbett set forth, after an interval of six months, on his Rural Rides. He spent two days in Hertfordshire and Buckinghamshire and his description of the crops reads as familiarly as an extract from an agricultural journal of to-day. He notes that near "the Wen," by which epithet he persistently speaks of London, the hay was all in rick, because the farmers had the "first haul of the Irish and other perambulating labourers," but that farther out, about Stanmore and Watford, a third of the grass still remained to be cut. He reports a very large hay-crop, which would be sold in London at £3 per load, *i.e.*, 18 cwt. The price of meadow hay in London now is from £5 to £6 per ton. Cobbett interjects the remark, which had a political point long since blunted: "here the *evil* of '*over production*' will be great indeed!"

When he comes to the corn-growing districts of Hertfordshire his observations reveal the mind of the practical farmer. The crops, and especially the barley, are very fine and very forward, although the wheat in general does not appear to be a heavy crop, "the ears seem as if they would be full from

bottom to top." He proceeds: "we have had so much heat that the grain is pretty sure to be plump, let the weather for the rest of the summer be what it may." After referring to his experience in America, where, he states, about fifteen days with the thermometer at 90 degrees, before the ear forms, ensures the maize crop, however unfavourable the weather may be afterwards, he continues: "This tallies with the old remark of the country people in England that '*May* makes or mars the wheat'; for it is in May that the ear and the grains are *formed*."

Not all the crops he saw impressed him so favourably. About Chesham "the barley, on the land that is not very good, is light, begins to look *blue* and the backward oats are very short," while around High Wycombe, a district which he regards as "an average of England as to corn crops," the wheat would be a fair average crop and very early; barley, oats and peas light; and beans not half a crop. Nevertheless, the farming report generally is optimistic. Already there has been gathered "such a crop of hay as I believe England never saw before"; the sun "will have done more to enrich the land than all the dung-carts" and, "in short, this is one of the finest years I ever knew."

Whether it was due to the fine weather, or the appearance of the crops, Cobbett found rather less cause than usual, in these two Rides, for censoriousness. He girds, it is true, at the Scotchmen whom he found in gentlemen's gardens, and remarks that the division of work among the nations is curious, all the mowers being English and all the haymakers Irish, while the Scotchmen "toil hard enough in Scotland, but when they go from home it is not to *work*, if you please." They leave the back-breaking, sweat-extracting work to others who have less "prudence." This leads to a characteristic apothegm: "The great purpose of human art, the great end of human study, is to obtain *ease*, to throw the burden from our own shoulders and fix it on others." This is, however, the expression of a mood, for at other times Cobbett preached vehemently the dignity, the duty and the happiness of work. But the spontaneity and the inconsistency of the chronicle, which is in fact a spasmodic diary, are the distinction of the Rural Rides.

One reason why the prospect pleased him on this occasion was that he did not see more than three acres of potatoes. These usually excited his vituperation. "Ireland's lazy root"

was one of his mildest descriptions, and it enabled him to combine in the same anathema two of his chief aversions—potatoes and popery. The pigs and potatoes campaign of to-day would have placed Cobbett in a dilemma, for he consistently glorified the one, and condemned the other. It is certain, however, that no dilemma would have long embarrassed him.

The pleasant sight of "the most interesting of all objects," the "neatly kept and productive little gardens round the labourers' houses," which he describes as an "honour to England," give occasion for the comment: "We have only to look at these to know what sort of people English labourers are: these gardens are the answer to the *Malthuses* and the *Scarletts*. Shut your mouths, you Scotch economists; cease bawling, Mr. Brougham, and you Edinburgh Reviewers, till *you* can show us something, not *like*, but approaching towards a likeness of *this*." The pertinence of this sound and fury escapes us now, but it was apparent enough at the time, and we can at any rate recognise it as authentic Cobbett.

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REPORT OF THE INTELLIGENCE DEPARTMENT OF THE MINISTRY.

THE Intelligence Department of the Ministry is charged with duties relating to agricultural education and research, horticulture, the improvement of live stock, the destruction of rats, and diseases of animals. A Report on its work, covering the two years ending 31st March, 1921, which has just been issued,* is therefore deserving of the closest consideration by farmers. The period covered by the report saw the termination of many "war-time" activities, the introduction of many new schemes to meet altered conditions due to the War, and, generally, a big development of Intelligence work to correspond with the increased importance now attached to agriculture by the public. The Report under notice contains not only an account of work accomplished but a statement of the policy underlying it, and is therefore of quite unusual interest.

Agricultural education is carried out by Agricultural Colleges (including University Departments of Agriculture) and by Local Education Authorities. To these bodies the Ministry makes grants-in-aid, and is charged with some responsibility for the proper spending of the money. The Institutions for higher education provide courses of instruction covering two

* Report on the work of the Intelligence Department, Ministry of Agriculture and Fisheries, for the two years 1919–21: H.M. Stationery Office, Imperial House, Kingsway, W.C.2. Price 5/-.

or three years or longer: from the University Departments of Agriculture is recruited the stock of future teachers and experts; while the Agricultural Colleges, offering a slightly different type of instruction, concentrate more particularly on the training of the practical farmer. In both cases, a sound preliminary general and scientific education is required, and the colleges should be entered from the secondary school. There remains the much larger class of small farmers who cannot afford the time for a long course of instruction, but who require some fundamental technical instruction that will put them in touch with the best modern farming methods. This type of instruction comes within the purview of Local Education Authorities, to whom is entrusted the carrying out of the Farm Institute scheme (see p. 400). Twelve Institutes are now in operation (including two established by private benefactions), and in five other cases properties have been purchased for development when funds permit. A general review of other educational activities of Local Authorities, including organised day courses, experimental and demonstration work, etc., is given in the Report, which also contains an account of the various schemes adopted for the agricultural training of ex-Service officers and men.

Research.—The points most noteworthy in regard to agricultural research are the establishment of graded salary-scales for research workers, with security of tenure for the higher grades, and the setting up of a Research Council to secure common action between the research institutes and to obviate duplication of effort. There has been a big all-round development of research activity, and in the case of horticulture and dairying research large capital grants have been paid for the purchase of land and the erection of buildings. The period saw the inception of the National Institute of Agricultural Botany,* a much needed link between the scientific plant breeder and the farmer. The research scheme includes an "advisory service," with specialists in chemistry and plant pathology attached to the Agricultural Colleges to study local problems and to advise farmers on plant diseases and on soil and fertiliser questions. Periodical conferences have been initiated between these advisers and members of the County Staff in their areas, to co-ordinate advisory work and ensure that the ground is well covered. At certain intervals, too, the advisers confer at the Ministry.

* See the account of the Institute in this *Journal*, March, 1922, p. 1072.

Horticulture.—The War revealed the need for greater attention to horticulture, not only because of the increase in small-holdings and allotments, but in connection with the "normal" industry—the large scale cultivation of fruit and vegetables—which greatly needs technical assistance. The Horticulture Division has therefore been enlarged, and a Controller of Horticulture has been appointed, and is assisted by the Horticultural Advisory Council, representing all sections of the industry. Fundamental investigations are conducted at the research stations at Long Ashton, East Malling and Waltham Cross. Demonstration fruit and vegetable plots have been established in most counties under the control of Local Education Authorities. A survey of orchards in the west of England, many of which are greatly neglected, was carried out as a preliminary to demonstrating the need for renovation. By these and other means the standard of horticultural education throughout the country has been raised. Another important side of the work had regard to plant diseases and the administration of the Destructive Insects and Pests Acts, and a full account of the action taken appears in the Report.

Live Stock Improvement.—The Live Stock Branch administers, *inter alia*, the Ministry's live stock and horse breeding schemes, under which grants or premiums are awarded to secure the provision of bulls, boars and horses, and to encourage the keeping of milk records. These schemes have been in operation for some years, and their success in raising the quality of stock and showing the importance of using good sires is generally accepted and appreciated. A marked development in milk recording is reported, records being kept of 61,300 cows in 1919-20 and 38,000 in 1918-19, as compared with 20,000 in the preceding year.

Dairying.—Under the head of Dairying the Report describes the action taken in encouraging the formation of milk depôts, to deal with surplus milk, and of cheese schools, whether travelling or co-operative. The establishment of a co-operative cheese school has in nearly all cases resulted in the local farmers forming a registered co-operative dairy society, with successful results. A small experimental factory at Haslington, near Crewe, was set up to discover whether it is commercially practicable to convert whey (an undesirable by-product in cheese factories) into lactose. The experiment has not gone far enough to justify a decision. Three experimental arable dairy holdings have been established to test the commercial possibilities of

milk production on small holdings of 20 to 30 acres. Much attention has been given to the question of clean milk production, and the desirability of promoting this is being commended to Local Authorities.

Small Live Stock.—Another field for development concerns the small live stock industry—chiefly poultry, rabbits and goats—which was badly organised and to some extent overlooked before the War, but is now recognised as an important source of cheaply-produced food. Education and research are needed, and the Report shows the action taken in promoting such schemes as the Ministry's Egg and Chick Distribution Scheme, and in furthering research into poultry and rabbit problems. The Scheme for the establishment of a National Poultry Institute was originated during the period. The Poultry Advisory Committee, set up by Lord Ernle in 1917, was reconstituted in 1920, the new Committee consisting of six members nominated by the National Poultry Council and three by the Ministry.

Diseases of Animals.—In connection with animal diseases the period was marked by an outbreak of rabies—with a total of 923 cases—which was effectually stamped out, and by the biggest invasion of foot-and-mouth disease which this country has known for 30 years, and which was also successfully dealt with. An important change in the official procedure for dealing with animal diseases is recorded. Before, the administration was entrusted to the Animals Division, while the Veterinary Department dealt with technical matters and research. Research is, however, rapidly discovering alternative methods of control, and the connection between scientific and administrative knowledge grows more intimate. The control and whole conduct of administration have therefore recently been put into the hands of the Chief Veterinary Officer.

Amongst the miscellaneous schemes referred to are the Sugar Beet Factory at Kelham, erected by the Home-Grown Sugar Corporation, half the capital of which was subscribed by the Ministry, and the Methwold estate of 1,500 acres of poor sandy soil, which the Ministry is endeavouring to reclaim.

The above notes show that the Report covers a wide field and should appeal to a large circle of readers. It should be particularly useful to local authorities—whether county committees or governing bodies of colleges and research institutes—to whom the execution of much of the work is entrusted, and without whose whole-hearted co-operation little progress would have been possible.

PROFITABLE EGG FARMING IN THE BASINGSTOKE DISTRICT.

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WITHIN the last eleven years there has been, in the Basingstoke district of Hampshire, a remarkable development of commercial egg farming which started when Mr. S. G. Hanson settled there in 1911.

Mr. Hanson had previously been poultry farming in Vancouver, and when he returned to this country he purchased a farm-house, buildings and 10 acres of land, at Kempshott, some 3 miles from Basingstoke, which formed part of a 120-acre farm. The soil is light and on chalk, and although well suited to poultry it had previously given poor returns when worked as a general farm.

At the start Mr. Hanson was watched by many who had had previous experience of poultry and they were doubtful as to what success he would have, but these doubts have long since passed away, his farm soon proving successful.

On the 120 acres which comprised the land belonging to the old farm, many poultry farms of various sizes have now sprung up with land from an acre or less up to 7 acres, supporting from 25 to 30 families. In some cases additional labour is employed so that some 100 people are now provided for on the same acreage which previously only supported 5 or 6 people.

The ideas introduced by Mr. Hanson* differed widely from the methods hitherto in force for poultry keeping in this country. Poultry had not received the same attention as other stock, and although, no doubt, in some cases a profit was made, there was too often a lack of system attended by a great deal of unnecessary labour.

Secrets of Success.—Perhaps one of the chief secrets of the success of the Hanson system is that the main object of the farm is the production of eggs for table purposes, and every attention is given to that end. No attempt is made to produce table birds, in fact in many instances the young cockerels are disposed of as soon as the sex can be detected. Neither is pedigree breeding carried out, the egg farmer relying on the "breeder" farmer to supply him with sittings of eggs, or

* See "Commercial Egg Farming," by S. G. Hanson, published by Constable & Co., which gives a detailed account of the system.

cockerels for mating up his breeding pens with which to replenish his stock.

The breed kept is in practically every case the White Leghorn, which so far has proved the most economical and best suited for the particular object in this district.

Everything is done to reduce labour to a minimum, and in consequence the stock are housed in large buildings of the scratching shed type, up to 600 birds being run in one flock. In one or two cases even 1,000 or more birds are kept in one flock, but the general rule on farms of the larger type is to run the birds in units of 400 to 600.

The pullets are housed apart from the hens and the latter are mated only during the breeding season when fertile eggs are required, it being preferable to produce infertile eggs for consumption, besides which the cost of feeding unnecessary male birds is saved.

Certain conditions stand out as of major importance, one being the necessity for a perfectly dry, light and well-ventilated house, with plenty of scratching litter which must be kept dry. Fowls under natural conditions lay chiefly in the spring and summer, but by providing suitable houses with dry floors and well protected from the weather, it has become possible to obtain an abundance of eggs during the winter, from young stock hatched at the right season. The land required, providing it is of a suitable nature, being fairly dry and well drained, is not great. One acre on this system will be found sufficient for 400 birds, but it must be so fenced that only one half is in occupation at a time, whilst in the run which is " resting " a kale or other suitable crop is grown to serve the double purpose of cleaning the land and supplying green food for the stock.

Incubation and Rearing.—Artificial incubation and rearing are practised, and on many of the larger farms the Mammoth Incubator, heated by means of an anthracite stove, is used. These machines have proved entirely satisfactory and are a great labour-saving device, especially when fitted, as practically all modern machines are, with an egg turning arrangement, whereby all the eggs in one side of the machine can be turned at once by simple movement of a handle outside the machine.

Whilst the system of incubation is practically universal various systems of brooding chickens are adopted. On some farms a large brooder house is installed, heated by means of hot water pipes running through a number of divisions, each of which will accommodate up to 150 chickens. On other farms

a separate unit house, having a capacity for 500 chickens, is used, the heat in this case being provided by a stove and large hover. The fuel used in both cases is anthracite coal.

Success has been obtained by both methods, but on the whole perhaps the majority favour the pipe system. With the pipe system only one fire has to be attended to whereas with the hover it may mean 6 or 8 or even more separate fires to be stoked and attended to, which greatly adds to the labour.

On the other hand, when the hover system is used the house is generally made of sufficient capacity to accommodate the pullets until they are about five months old and ready to be placed in their permanent laying quarters, the land adjoining the house being so penned off that a change of ground can be given, and the land completely rested for seven months of the year.

With the pipe system the chickens up to 6 weeks of age are allowed comparatively small outside earth runs which are only occupied for a short time. They are then thoroughly disinfected and seeded down so as to produce a certain amount of green food whilst unoccupied. After leaving the brooder house, the growing stock are accommodated in small colony houses.

All grain is fed in the house litter, so as to promote exercise, and the mash is given in a dry state, in suitable hovers to prevent waste, a system which reduces labour considerably.

The water supply is a problem on which great care must be bestowed, and whenever possible it is a great advantage to have it laid on in close proximity to the houses, otherwise a large labour bill for carting would have to be faced.

Laying Houses.—The general practice now with regard to the laying houses is to make them somewhat deeper than is recommended in Mr. Hanson's book, 14 ft. being considered about the best dimension. The construction is cheaper, the houses need not be so long, and they are easier to work. It has been found that old Army huts make excellent laying houses. Also, brooder houses for use with the pipe system are now, as a rule, constructed with the roof sloping from front to back. It should be noted that April is considered the most suitable month for hatching out White Leghorns for producing pullets for autumn laying, and as in some seasons the weather is hot during that month, it has been found that the type of brooder house used by Mr. Hanson is apt to become over-heated during the day.

It must be borne in mind that Mr. Hanson laid out his farm in 1911 and others have benefited by his experience, and were he starting again he would no doubt carry out these modifications himself, though the general system would remain the same.

A Successful Modern Egg Farm.—At Woodmancott, some 8 miles from Basingstoke, there is one of the most modern and best equipped commercial egg farms, which is an example of what can be done in modern egg farming. It is owned by Mr. A. F. C. Holdaway, who in 1914 was assisting his father in running a bakery and grocery business in two villages; he was not satisfied with the prospects, and after having an interview with Mr. Hanson decided to start an egg farm. At first he rented 7 acres of land on which he built a Hanson type laying house and retained a laying stock of 600 birds. At the same time he continued his other business. The farm was gradually enlarged until 1919, when the grocery business was disposed of. By this time Mr. Holdaway had built up a plant and stock of 2,500 laying birds, and in addition had obtained the freehold of 21 acres. He was then joined by his father and two brothers, and at one time also had the assistance of a brother-in-law, who undertook a great deal of the work of constructing the plant, but who has since left the farm. In addition to Mr. Holdaway, his father and two brothers, one poultryman and one lad are regularly employed on the farm and one additional casual helper is usually taken on during the busy season in the spring and early summer so that six workers are regularly employed to run the farm.

The plant now consists of four large laying houses. The first one to be constructed was 270 ft. long by 9 ft. wide, but the remaining three are of an improved design, being 110 ft. long by 14 ft. wide, 8 ft. high in front and 5 ft. high at the back. The interior is divided into 10 bays by partitions extending 7 ft. out from the back of the house. Each of these three new houses accommodates 500 birds, and is placed in the centre of 1½ acres of land which is divided into two runs, the unoccupied portion nearest the house being ploughed up and sown with kale or other forage plants, the remainder being permanent pasture.

A large brooder house has been installed, having a capacity for 3,750 chickens and is heated on the hot-water pipe system. The first portion of the brooder house to be constructed was on Mr. Hanson's design but further extensions were built with

the highest part of the roof in the front. The total length of the brooder house is 170 ft. and it is 12 ft. wide including the attendant's gangway, which is 3 ft. in width. It is divided into 30 compartments or pens to take 125 chickens in each.

The incubator capacity is 4,000 eggs in 400-egg machines of the hot-air type. The attention to these machines absorbs a great deal of time and it is probable that a Mammoth machine will be installed in the near future.

The breed kept is White Leghorn. Incubation commences the first week in March and the last batch of chickens is hatched out at the end of April.

The marketing of eggs in this area is carried out on co-operative lines. In 1912 the Oakley and District Co-operative Society was formed, and now has a membership of about 70. It also deals in food stuffs for the benefit of the members. It is run on somewhat unusual lines, as the eggs are not purchased by the Society from the producers, but the Society finds a market for the eggs and all payments are received and dealt with through the Secretary of the Society, each member notifying the Secretary of the number of cases that he has despatched every time the lorry calls.

A levy of 3d. per case of 30 dozen eggs sent is charged to members to cover administrative expenses. All the eggs are sent to London and the majority go by road transport, which is provided as a private enterprise by one of the members of the Society. The lorry calls at the farms for the eggs and also brings back the empties, thus saving much valuable time to the producer.

It is the aim of the Society to obtain as high a price as possible for the members' eggs, and as these are packed and loaded direct by the producers into the lorry, the working expenses are cut down to a minimum.

Whilst what has been done in this area indicates that poultry farming, if properly organised, is undoubtedly a successful form of agriculture, it should be borne in mind that in common with other businesses it calls for hard work, knowledge, power of observation and business capacity, if the best results are to be obtained. What the future may bring forth it is impossible to say, but so long as there is a sufficient margin between the cost of feeding stuffs and the selling price of eggs, it is a form of agriculture that is capable of development in many parts of the country. In recent years the high price of eggs has doubtless stimulated poultry keeping, but even with a somewhat narrower margin between the price of eggs and the cost of

poultry foods it is anticipated that the stimulus will continue to make itself felt.

The force of example has been the principal feature in the development of modern poultry keeping in this area and there is no doubt that the district and the poultry industry as a whole owe much to Mr. G. S. Hanson in this respect.

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FAILURE OF BLACK YEO OATS IN GLAMORGAN IN 1921.

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THE failure of Black Yeo Oats from Herefordshire was reported from 10 farms in the County of Glamorgan, the seed sown on all these farms having come from the same source. Inquiry elicited the following facts:—

1. Black Yeo Oats are a winter variety.

2. Samples drawn from the bulk had been sent to the Official Seed Testing Station and the oats germinated 97 per cent.

3. The appearance of the oats in sample and in bulk was quite normal and gave no evidence of any defect. When the failure of the crop was reported a further sample was tested and this germinated 94 per cent. Approximately 100 acres of this variety of oats were sown in Glamorgan, chiefly in the Vale, in the spring of 1920, and the crop was everywhere a failure.

A point to be noted in connection with the failure of the crop is that it was probably partially due to the weather of 1921. In March the rainfall was about 4.42 in., which practically prevented the sowing of oats on the lias clay soil of the Vale under suitable conditions. April was a very dry month, but the oats started growth and made a little progress in May. During June, however, there was only about 0.15 in. of rain in the Vale, and the oat crop, after making a poor start, became a total failure.

Discussions with farmers who had grown these oats led to the supposition that the grain had been heated, as their experience was that heated samples of oats produce a healthy shoot but weak rootlets. The dry climatic and soil conditions prevailing during the spring did not admit of the oat crop becoming properly established, and the retarding effect of the following dry season was naturally greater on stiff lias clay than on loams and lighter soils.

Samples of the grain were subjected to test at the Plant Breeding Station at Aberystwyth together with a sample of Radnorshire Sprig Oats which had failed to establish itself at that Station. The Radnorshire Sprig, like the Black Yeo, had all the appearance of being a perfectly satisfactory sample—it had no odour and the grain was plump and bright, but in this case the laboratory germination test proved it only to be capable of a growth of 23 per cent.

A laboratory test conducted at Aberystwyth on the Black Yeo confirmed that of the Official Seed Testing Station, but revealed the fact that the energy of germination (germination in three days) was decidedly poor. Microscopic examination of the kernels did not reveal any apparent defect in the embryo.

A pot experiment was consequently made to investigate the matter in greater detail. The procedure adopted was as follows:—The Black Yeo and Radnorshire Sprig were tested against a sample of Culberson as control. The Culberson had given a perfectly normal laboratory germination of 99 per cent., with a high energy of germination, and the lot from which the sample had been drawn had given rise to a thick "stand" and had made good growth on the plots. The seed was sown in 5-in. pots (five seeds per pot). Twenty-five pots constituted a "series." The experiment was set up on 27th June, and subsequently as required one series received "full," *i.e.*, normal watering, and whenever this series was watered a second series was given "half" the normal watering, a third series "quarter" of the normal watering and a fourth series "double" the normal watering.

The chief results obtained are set out in the Table hereunder:

PARTICULARS OF TESTS.	Culberson Control: Laboratory germ. 99 per cent.		Radnor Sprig: Laboratory germ. 23 per cent.		Black Yeo: Laboratory germ. 97 per cent.	
	Percentage of seedlings 17 days after planting.	Final percentage of established plants 33 days after planting.	Percentage of seedlings 17 days after planting.	Final percentage of established plants 33 days after planting.	Percentage of seedlings 17 days after planting.	Final percentage of established plants 33 days after planting.
Normal watering ...	97	98	16	18	26	91
Half watering	97	91	11	14	17	73
Quarter watering ...	75	87	13	14	2	25
Double watering ...	97	86	5	6	38	63
Difference between:						
Full and half watering	0	−7	−5	−4	−9	−18
" " quarter "	−22	−11	−3	−4	−24	−66
" " double "	0	−12	−11	−12	+12	−28

(−) = decrease and (+) = increase compared with normal watering.

The figures are interesting from several points of view. In the first place they show that differential tests conducted under conditions less favourable to germination and growth than ordinary conditions are competent to reveal defects in a sample that might be overlooked if only the ordinary test was conducted; and in any event to bring out such defects more prominently. Thus with double watering the behaviour of Radnorshire Sprig, relative to Culberson is even more marked than under normal watering.*

It will be seen that the effect of half watering has been but slight on the healthy control sample, but that quarter and double watering have had a very appreciable influence on the percentage of finally established plants—quarter watering in particular having shown a striking decrease in respect of energy of establishment.

In view of the complete failure of Black Yeo under the droughty conditions prevailing during the season of 1921 it is of particular interest to find that whereas Radnorshire Sprig was adversely affected to the greatest extent by double watering, the Black Yeo was affected to the greatest extent by quarter watering. The energy of establishment of Black Yeo under quarter watering was almost negligible and actually less than that of Radnorshire Sprig, although Black Yeo showed a "normal condition" germination of 97 per cent. and Radnorshire Sprig but 23 per cent.

It is thus evident that the seeds of Black Yeo were not normal, and although attaining to a high percentage of germination were defective in some physiological respect which rendered them particularly and exceptionally susceptible to the influence of drought. This showed itself also in the poor energy of germination and of establishment under normal conditions. It should be added that the growth habit of the established Black Yeo plants confirmed that this is a Winter Oat.†

The growth of established plants did not differ appreciably either between the three samples or between the differential waterings, except that those subjected to quarter watering were

* These results are in keeping with those previously recorded by Stapledon (Seed Studies: Red Clover, with special reference to the County of Origin of the Seed. *Jour. Agr. Sci.*, X. (1), Jan., 1920), who found that tests conducted with Red Clover at temperatures above the optimum brought out defects of the seed in a very striking manner.

† That this circumstance as such was without influence on the complete failure in Glamorgan is suggested by the fact that black winter oats sown in the spring in the trials at Aberystwyth established themselves normally and produced relatively good crops.

at the end of the month only about half the height of the series receiving normal, half and double watering respectively.

The experiment was not continued for longer than 33 days when all the plants were covered with *Erysiphe graminis* but this in no way influenced the results above referred to.*

In view of the frequent failures of cereal crops that occur in Wales, and in the areas of high rainfall in England, in a year following an adverse harvesting season, the question of the suitability for seed of damaged or apparently damaged grain is an exceedingly important one.

It is possible that the effective damage to the Radnorshire Sprig or Black Yeo may not have been the direct result of heating in the stack or in store, but may have been due to the grain being over kiln dried while in an "unripe" soft and damp condition.

Damage arising out of adverse harvest conditions therefore calls for investigation from two points of view—(1) to endeavour to find out how best to counteract such influences, and (2) to establish a laboratory or other simple and rapidly conducted test upon the result of which it would be possible to form a correct opinion as to the potential crop-producing capacity of the seed.

This question has been under tentative inquiry at Aberystwyth for a number of years; it is, however, always difficult to obtain sufficiently accurate particulars of the conditions which have led to the damage, real or supposed, in respect of samples received.

The clause in the Seeds Act relative to cereals affords very considerable, although, as the case of Black Yeo here discussed indicates, not complete protection. Tests conducted on a considerable number of samples of more or less well known history during the past 8 years at Aberystwyth seem to indicate, however, that in most cases badly damaged samples are incapable of germinating over about 60 per cent. and frequently germinate no more than 10 per cent.†

It is suggested that additional protection would be provided if the energy of germination was always stated, in the case of cereals, on the reports sent out from the Official Seed Testing Stations for England, Scotland and Ireland, and that further

* The pots had of course to be kept in a frame always covered at night and in the day time whenever it rained.

† This view was also borne out by results on samples tested at the Official Seed Testing Station (then at the Food Production Department) in 1917–18. For instance, 6 per cent. of the wheat samples tested germinated below 50 per cent., as did an appreciable proportion of the oat and barley samples.

experimentation on the lines of the differential soil tests here discussed should lead to the establishment of a simple and effective test.

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ANTHRACNOSE OF THE CUCUMBER UNDER GLASS.

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UNDER the name " Spot " disease, the commercial cucumber-grower groups all the leaf diseases of that plant. The most important leaf spot diseases of the cucumber are those caused by the fungi *Cercospora melonis* and *Colletotrichum oligochaetum*, while under conditions of abnormally high humidity *Cladosporium cucumerinum* may be a destructive parasite.

During the years 1897 to 1907 *Cercospora melonis* appeared in the Lea Valley and caused great destruction, but the introduction of the variety Butcher's Disease Resister in 1903, which is immune to this fungus, and of methods of soil sterilisation led to its ultimate disappearance. At the present time *Cercospora melonis* exists only in isolated parts of Great Britain. The *Cercospora* disease was soon followed by another caused by *Colletotrichum oligochaetum*. This is the Anthracnose of cucumbers which is now the most important leaf spot disease of the cucumber in this country, and causes many thousands of pounds' damage each year.

Disease Symptoms.—*C. oligochaetum* has been observed to cause a " damping off " of cucumber seedlings and young plants on several occasions, but this form of the disease is not common. The fungus attacks the young plants at approximately the ground level, and causes a shrinkage of the tissues, so that the plant falls over. It spreads rapidly up the plant and gives rise to spore masses in about five days.

In its commonest form the disease first attacks the leaves and may appear at any time during the life of the plant. It has occasionally been observed during the propagating period, but generally it does not appear until March or April when the plants are well established in the houses and some fruits have been cut. The time at which the plants are attacked bears no relation to their age, but is determined by the presence of suitable sources of infection. On the leaves, the spots generally first appear above a vein, presumably because the spores are washed into

the hollows of the leaf surface by overhead damping. The lesions commence as pale green water-soaked spots barely distinguishable by the untrained eye, but quickly assume a characteristic appearance, becoming dry and reddish brown in the centre with a yellowish water-soaked surrounding zone. The spots vary in shape, being almost circular in areas untouched by any large vein, but irregular patches where they form over a vein. They frequently crack in the centre and the desiccated tissue may not infrequently be beaten out by the daily overhead damping. The spots increase rapidly in size, become more circular and blotch-like, finally coalesce, and the leaf dies. At the final stage the leaves have a scorched appearance and are covered with spots.

As the disease advances, lesions develop on the leaf stalks and stems, showing as sunken water-soaked areas which rapidly become dry and powdery. They are usually at first linear in shape but may spread round the stem. Under glasshouse conditions it is not uncommon to see the soft tissues of the stem completely destroyed, leaving the fibrous part exposed, and causing the death of the plant above the point of attack. On stem and stalk lesions abundant spores are produced, giving rise to a pinkish colour which turns black with age.

The lesions on the fruits appear as pale-green water-soaked, sunken areas, the surface of which, owing to abundant spore production becomes pink in colour and finally black. The tissues under the lesion are destroyed and a cavity is produced, which is exposed by the cracking of the surface above. When the leaves are attacked, the health of the plant is impaired only by the serious reduction of leaf area, but lesions on the stem are more serious and may cause the rapid death of the plant by destroying the tissues.

The Organism Causing the Disease.—*Colletotrichum oligochaetum*, Cav., was readily isolated from infections on leaves, stems and fruits. Proof that it causes the disease was obtained by spraying young cucumber plants with a water suspension of spores, and keeping them under suitable conditions.

The fungus has been described by Cavara, and later workers. In the present study it has been cultivated on a wide range of artificial media.

Sources of Infection.—The fact that the fungus will thrive upon such substances as new and rotten wood, straw, and cotton wool, provided that these are kept sufficiently moist, led to a systematic examination of glasshouse structures, boxes, wooden tanks, " flats " and heaps of manure.

Material was collected with instruments sterilised by dipping in spirit and flaming with a pocket petrol lighter, and was conveyed to the laboratory in sterilised plugged specimen tubes. The investigations were carried out in nurseries where the disease had never appeared, as well as those badly attacked in the previous year, and examinations were made immediately the crop was removed and also after the houses had received the usual winter treatment prior to the planting of the next month's crop.

The following materials were examined :—

(1) General debris found between the "overlaps" in the glass structure
(2) Samples of decayed wood from holes in "plates," "bars" etc.
(3) Samples of old decayed posts.
(4) Samples of decayed wood from tanks in the houses.
(5) Samples of paper used for filling cavities and packing warped ventilators.
(6) Samples of straw manure from the beds.
(7) Samples of straw manure from the original heap.
(8) Market boxes or "flats."

Part of each sample was examined in the laboratory, while another part was placed in a flask, kept moist for 14 days and shaken up with water which was afterwards sprayed over young cucumber seedlings.

Material from glasshouses where the disease had not occurred previously did not yield the fungus. Materials obtained from diseased houses showed the fungus to be present and young plants were infected by many of the water suspensions tested. The main conclusions may be stated briefly as follows :—

(1) The present methods of cleansing glasshouses during the winter months are not sufficient to exterminate centres of infection of *Colletotrichum oligochaetum* which may exist from a previous diseased crop.

(2) Infection is more abundant immediately after the diseased crop has been removed than after the period of winter rest, but sufficient survives to carry the disease over from one season to another.

(3) The fungus may live occasionally in the debris which collects in the overlap between two panes of glass, but except in old houses this does not form an important source of infection.

(4) The fungus may carry on a saprophytic existence in rotten wood in the house and paper used for blocking holes, and these constitute important sources of infection.

(5) Straw manure removed from beds in infected houses was found invariably to harbour the parasite and when allowed to remain unburnt in a heap outside the houses—a common practice—must be a centre for the spread of the fungus.

(6) The examination of "flats" was unsuccessful in obtaining positive evidence of their transmission of this fungus, but observations upon the incidence of this disease in commercial nurseries indicate the probability that it may frequently be carried in this way.

(7) The examination of straw manure has shown it to be such an important source of infection, that special attention was given to it, and straw manure from the following sources was examined :—

(a) Straw manure fresh from country farms.
(b) Straw manure from country farms after lying in a heap adjacent to a heap of old diseased cucumber plants.
(c) Straw manure from local stables.
(d) Straw manure from London.

The heaps of manure were carefully searched and suspected material taken to the laboratory for further study. Suspensions were also prepared by shaking 1 lb. of manure with 1 gallon of water for five minutes and straining through a fine wire sieve. The liquid obtained was sprayed over young cucumber plants kept in a humid chamber. *C. oligochaetum* was found in nine different samples, and in one of these the pink spore masses appeared on half-decayed straw at the surface of the heap. In no case was the fungus found in manure fresh from country farms or local stables. In five cases it was found in the manure heaps adjacent to those of decaying cucumber remains, and in four cases in manure freshly imported from London stables.

The possible importation of disease in manure from town stables, is important to growers, and especially to those of glasshouse produce. Much diseased fruit is sold in East London and Dr. W. B. Brierley, of Rothamsted Experimental Station, informs the writer that cucumbers badly attacked by *C. oligochaetum* are frequently to be seen on street stalls in those parts, the most diseased specimens frequently being thrown into the roadway and trodden under foot. This infection may gain access to stables and thence return to the grower.

The writer's investigations have shown that in nurseries where *C. oligochaetum* has appeared for the first time, it has in certain cases been imported in the straw manure, and further investigations are necessary to determine the best way of sterilising the manure without reducing its value.

Other important sources of infection are the water supply and the clothes of workers in the infected nurseries, the latter having been found to be a most important method of disease transmission in the Lea Valley.

(To be concluded.)

NOTES ON FEEDING STUFFS FOR AUGUST.

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Ministry of Agriculture and Fisheries.

Value of Yellow and White Maize Meal.—During the past year inquiries have been received as to the value of white maize meal and yellow maize meal for stock feeding. As far as our knowledge went at that time, there was practically no difference in the value of these materials for feeding purposes. Recent work in America, however, has shown that our views with regard to these products need some modification. Some experiments were carefully carried out with young pigs as to the value of yellow varieties of corn and white varieties of corn for feeding. In America this is a very important point, since a large area exists in which maize forms the staple product for feeding stock. As a result of these experiments, the following facts were ascertained.

Where there is no pasture or legume hay available, yellow maize is far superior to white maize for feeding pigs weighing less than 100 lb. live weight. The difference in value is assigned to the fact that yellow maize is rich in fat-soluble vitamin, whereas white maize contains too little. Some pigs weighing 60 lb. fed on white corn and skim milk did well for a time, but later developed rickets, which is known to pig keepers as paralysis or rheumatism. All but three in one lot died.

Other pigs, fed on skim milk and white maize until they had got into bad condition, were changed to yellow maize and skim milk, and made rapid recovery, showing rather conclusively that the ration of white maize and skim milk lacked fat-soluble vitamin. On the other hand it was shown by feeding experiments that where pigs have access to pasture, or are given chopped lucerne hay or clover, white maize is as good a feed as yellow maize.

It may therefore be stated generally that white maize is as useful for feeding as yellow maize, except in cases where the general dietary contains little fat-soluble vitamin, when yellow maize will prove of much greater value than white maize.

The Distribution of Vitamins in Farm Produce.—In previous notes, attention has been called to the three principal vitamins, *i.e.*, Fat-Soluble A, Water-Soluble B and Water-Soluble C Vitamin.

DESCRIPTION.	Price per Qr. s.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	56/6	504	12 11	1 0	11 11	71·6	3/3	1·74
Barley, English Feeding	38/–	400	10 13	0 18	9 15	71	2/9	1·47
„ Canadian No. 4 Western	35/3	400	9 17	0 18	8 19	71	2/6	1·34
„ „ No. 2 Feed	33/6	400	9 7	0 18	8 9	71	2/5	1·29
Oats, English White	37/6	336	12 10	0 19	11 11	59·5	3/11	2·10
„ , Black & Grey	36/–	336	12 0	0 19	11 1	59·5	3/9	2·01
„ Scotch White	38/–	336	12 13	0 19	11 14	59·5	3/11	2·10
„ Chilian	29/–	320	10 3	0 19	9 4	59·5	3/1	1·65
„ Canadian No. 2 Western	32/–	320	11 4	0 19	10 5	59·5	3/5	1·83
„ „ No. 2 Feed	28/6	320	9 19	0 19	9 0	59·5	3/0	1·61
„ American	27/–	320	9 9	0 9	8 10	59·5	2/10	1·52
„ Argentine	27/6	320	9 12	0 19	8 13	59·5	2/11	1·56
Maize, „	41/6	480	9 14	0 17	8 17	81	2/2	1·16
„ American	36/–	480	8 8	0 17	7 11	81	1/10	0·98
„ South African	37/–	480	8 13	0 17	7 16	81	1/11	1·03
Beans, Rangoon	8/–	112	8 0	1 15	6 5	67	1/10	0·98
Millers' offals—								
Bran, British	—	—	6 15	1 16	4 19	45	2/2	1·16
Broad Bran	—	—	8 10	1 16	6 14	45	3/–	1·61
Fine middlings (Imported)	—	—	9 15	1 7	8 8	72	2/4	1·25
Coarse middlings	—	—	8 17	1 7	7 10	64	2/4	1·25
Pollards (Imported)	—	—	7 12	1 15	5 17	60	1/11	1·03
Barley Meal	—	—	11 5	0 18	10 7	71	2/11	1·56
Maize „ S. African	—	—	8 10	0 17	7 13	81	1/11	1·03
„ Germ Meal	—	—	8 17	1 5	7 12	85·3	1/9	0·94
„ Gluten-feed	—	—	8 17	1 11	7 6	75·6	1/11	1·03
Locust Bean Meal	—	—	8 15	0 9	8 6	71·4	2/4	1·25
Bean Meal	—	—	13 10	1 15	11 15	67	3/6	1·87
Fish „	—	—	15 0	5 10	9 10	53	3/7	1·92
Linseed Cake, English (9% oil)	—	—	12 17	2 6	10 11	74	2/10	1·52
Cotton „ English (5% oil)	—	—	7 15	2 6	5 9	42	2/7	1·38
„ „ Egyptian (5% oil)	—	—	7 15	2 6	5 9	42	2/7	1·38
Coconut Cake (6% oil)	—	—	9 15	1 19	7 16	73	2/2	1·16
Palm kernel Cake (6% oil)	—	—	7 5*	1 9	5 16	75	1/7	0·85
„ „ Meal (2% oil)	—	—	6 2	1 9	4 13	71·3	1/4	0·71
Feeding Treacle	—	—	4 15	1 1	3 14	51	1/5	0·76
Brewers' grains, dried, ale	—	—	7 15	1 11	6 4	49	2/6	1·34
„ „ „ porter	—	—	7 0	1 11	5 9	49	2/3	1·20
„ „ wet, ale	—	—	1 0	0 8	0 12	15	–/10	0·45
„ „ wet, porter	—	—	0 15	0 8	0 7	15	–/6	0·27
Malt culms	—	—	8 12	2 3	6 9	43	3/–	1·61

* Prices at Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of June and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 9s per ton. The food value per ton is therefore £8 11s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 3d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·21d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

The effect of absence from food of Vitamin A is retarded growth ending in death, eye disease in some cases, and often onset of rickets.

The absence of Vitamin B leads to retarded growth ending in death, and in poultry, the disease known as "leg weakness."

The absence of Vitamin C leads to the onset of scurvy.

Several inquirers have asked for information as to the best sources from which to obtain these vitamins. Vitamin A is present in fish liver oils, green plants (including lucerne, clover, cabbage and hay), milk, egg yolk, animal fats, and some roots such as carrots, parsnips and mangolds. Vitamin B is present in seeds and grains, generally distributed in the germ and outside layers. It is also present in yeast, milk, egg yolk, green plants, carrots, potatoes, turnips, mangolds and beet. Vitamin C is present in green vegetables, particularly cabbage and its allied species. It is also present in orange and lemon juice, germinated seeds, swedes, turnips, potatoes, tomatoes and milk.

The aim of the farmer should therefore be to arrange his ration so that the diet contains sufficient of the three vitamins. With the table given this should prove an easy matter.

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Kirton Horticultural Station.

ONE of the most important features of the Ministry's scheme for instruction in practical horticulture is the establishment by County Education Committees of demonstration and experimental plots in the chief centres of production. This will enable growers to see the trials of varieties best suited to local conditions and of up-to-date methods of culture and manuring.

In the Holland Division of Lincolnshire the production of potatoes, peas, celery, green vegetables, fruit and flowers has for many years been a most important industry. The need for assisting growers with horticultural advice in the conduct of their industry has led to the establishment at Kirton, near Boston, of a Horticultural Station covering an area of 100 acres. This year there are being carried out trials of potatoes, peas, spring cabbage and cauliflowers, and a start has been made with fruit plots and trials of narcissi, daffodils and tulips.

Seventy per cent. of the area is devoted to vegetable trials, and of these perhaps the most important are those of spring cabbage,*

* See Trials of Spring Cabbage: J. C. Wallace, this *Journal*, March, 1922, p. 1121.

of which some twenty different varieties are being tested under commercial conditions in order to ascertain which are most suited for growing in the county. Manurial trials with cabbage are also being carried out to test the comparative advantages of nitrate of soda, nitrate of lime, sulphate of ammonia, and combinations of nitrate of soda with superphosphate. Fourteen acres are set out for trials of potatoes with the object of testing the comparative cropping capacity of some twenty varieties, and also of testing the value of "once-grown" seed as compared with seed direct from Scotland. Experiments are also in progress comparing the effects of the different potash and phosphatic manures on the potato crop.

The production of peas for drying and packeting green, has for many years been a thriving industry in the county, and nine acres of the trial grounds at Kirton are devoted to trials of varieties of peas with the object of comparing their cropping capacity and determining what are the most suitable manures.

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Admission of Canadian Cattle.—A White Paper (Cmd. 1722. 1922, price 3d.) has been published by H.M. Stationery Office, containing:—

(1) "Extracts from the Proceedings at the Conference of Prime Ministers and Representatives of the United Kingdom, the Dominions and India, 1921."

This is a verbatim report of the discussion at the Imperial Conference at which the Canadian Prime Minister pressed for the carrying out of the assurances claimed to have been given in 1917.

(2) "Memorandum on the Report and Recommendations of the Royal Commission appointed to inquire into the admission into the United Kingdom of Live Stock for purposes other than immediate slaughter at the Ports."

The terms of reference to the Commission are given together with the conclusions arrived at by it.

Export of Dogs to the Channel Islands.—Dogs may now be imported into the Channel Islands from *non-scheduled districts* in Great Britain (*i.e.*, districts in and from which movement is not restricted by Order of the Ministry of Agriculture and Fisheries in consequence of an outbreak of rabies) without undergoing a period of quarantine on arrival, provided they are accompanied by an export certificate from the Ministry of Agriculture and Fisheries (10, Whitehall Place, London, S.W.1) containing a full description of the dog, *i.e.*, breed, sex, age, colour and distinctive markings (if any) for identification purposes, and certifying (1) that the dog comes from an area in and from which the free movement of dogs is permitted, and (2) that the dog is not in quarantine at the time of departure for the Islands.

In addition to the export certificate referred to above the *Jersey Authorities* require that every dog shall be accompanied by a veterinary certificate testifying that it was in good health at the time of embarkation.

In order to obtain an Export Certificate, intending exporters of dogs from *non-scheduled districts* in Great Britain should apply to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1, for the necessary form of application.

Certificates are issued subject to the following conditions, viz., (*a*) that the dogs will be moved to the port for shipment as far as practicable by rail, (*b*) that they will be confined during the movement in a crate, box or other suitable receptacle, and (*c*) that on arrival at the port they will be conveyed without delay to a vessel for shipment.

Certificates are valid for 8 days only, including the date of issue, and must be handed within this period to the Harbour Master, or Deputy Harbour Master, on the arrival of the dog at the port of disembarkation.

With regard to dogs from *scheduled districts* in Great Britain or from *foreign countries*, an application in writing for permission to land the dog in the Islands must be made in the case of Jersey to the Committee of Harbours, Jersey, or in the case of Guernsey, to the States Office, Guernsey, stating the full description of the dog, the place from which it is coming and the port of embarkation. Permission to import the dog, if granted, will be subject to the following conditions, viz., (1) that the dog must be isolated for a period of six months at the Cattle Depôt, Albert Pier, Jersey, or at the States Quarantine Station, Guernsey, at the owner's expense, and (2) that a veterinary certificate must be produced previous to landing to the effect that the dog was in good health previous to embarkation.

A charge of 1s. 6d. per diem at the Cattle Depôt, Albert Pier, Jersey, or of 1s. per diem at the States quarantine station, Guernsey, will be made for food and attention. The respective Channel Island Authorities assume no responsibility as to the health of the dog during the period of isolation.

Foot-and-Mouth Disease.—There have been three further outbreaks of Foot-and-Mouth disease in Great Britain since 22nd June, the date referred to in the *Journal* for July, these outbreaks, which occurred in Derbyshire, Lancashire and Staffordshire, were all in districts already subject to restrictions with the exception of that in Lancashire, which necessitated the imposition of fresh restrictions over an area around Blackpool. The latest of these outbreaks occurred on 30th June. All the affected and in-contact animals were slaughtered, the total number being 127 cattle, 78 sheep and 15 pigs.

There has been no further development of the disease up to 21st July, and it has been possible to modify the restrictions very considerably except in respect of the districts immediately surrounding the latest cases.

The total number of outbreaks this year has now reached 1,124, of which 3 occurred in Wales and 102 in Scotland. The total number of animals slaughtered up to 21st July is 23,605 cattle, 21,712 sheep, 9,550 pigs and 48 goats.

Courses at Farm Institutes.

In connection with the article on Farm Institutes in this issue of the *Journal* (p. 400) attention is directed to the following particulars of courses which are held at Farm Institutes recognised by the Ministry. Fuller particulars than those given in the table may be obtained from the officers mentioned in column 5. As accommodation at all Farm Institutes is limited, early application for entry should be made.

County Council (or other body) responsible for Institute.	Name and location of Institute.	Description of Courses.	Fees. (Board, lodging and tuition unless otherwise stated.)	Address for further particulars.
ENGLAND.				
Cheshire County Council.	Cheshire School of Agriculture, Reaseheath, near Nantwich.	(*a*) Winter Courses of about 22 weeks' duration, in Agriculture and Horticulture. (*b*) Short supplementary courses during Summer Term. (*c*) Courses, intended for beginners, of practical training in farm or garden work.	Students resident in county, £1 per week. Other students, £1 15s. per week.	The Principal Cheshire School of Agriculture, Reaseheath, Nantwich.
Cumberland and Westmorland County Councils.	Cumberland and Westmorland Farm School, Newton Rigg, near Penrith.	(*a*) Winter Course (Agriculture) of 20 weeks, October to March, in science and practice of Agriculture with special reference to Dairy-farming and Stock-rearing. (*b*) Three Summer Courses (Dairying and Poultry-keeping) of from 4 weeks' to 12 weeks' duration, April to September. (*c*) Special pupils are admitted for practical training in Farm Management.	Westmorland students free. Cumberland students, £1 per week. Students from other counties, £2 per week.	The Principal, Newton-Rigg Farm School, Penrith, or C. Courtenay Hodgson (Secretary), The Courts, Carlisle.
Essex County Council.	East Anglian Institute of Agriculture, Chelmsford.	(*a*) Winter School of Agriculture of 20 weeks' duration, October to March. *Note.*—There is no farm attached to the Institute. All students previous to attending this course must spend at least one year on a farm, taking an active part in all farming operations. (*b*) Dairy School. Three courses of from 12 weeks' to 16 weeks' duration. N.D.D. 2 years' course (6 terms); also qualifies for diploma of B.D.F.A. (*c*) School of Horticulture. Course of three terms, viz., Autumn Term, 3 weeks; Spring Term, 4 weeks; Summer Term, 4 weeks. Practical instruction is given at the County Gardens.	(*a*) Residents in administrative County of Essex and County Borough of Southend, £5 for 20 weeks. Residents in County Boroughs of East Ham and West Ham, £12 for 20 weeks. Students from outside the county, £1 per week. (*b*) Residents in administrative County of Essex and County Borough of Southend, nil. Residents in county boroughs as above, 10s. per week. Pupils from outside the county, £1 per week. (*c*) Residents in administrative County of Essex and County Borough of Southend, nil. Residents in county boroughs as above, 10s. per week. Students from outside the county, 15s. per week.	The Principal, East Anglian Institute of Agriculture, Chelmsford. NOTE.—These fees are for tuition only.

		Course of 24 weeks, October-March. Summer course of 15 weeks, April-July. (*b*) Short courses of a few weeks' duration or upwards, in any of the above subjects can be arranged.		
Hertfordshire County Council.	Hertfordshire Agricultural Institute, Oaklands, St. Albans.	(*a*) One year's course in Agriculture, of three terms, commencing respectively October, January, April. (*b*) Dairying Courses (i.) One year's course, commencing October. (ii.) Summer Course, April to August. (iii.) Short courses (General Dairying). (iv.) Short courses in Special Dairy Subjects (Clean Milk Production, &c.). (*c*) Courses in Horticulture. (*d*) Four weeks' course in Agriculture for non-residential students. (*e*) One week's course in Clean Milk Production. (*f*) Courses in Poultry-keeping and Bee-keeping.	Students resident in county, £1 15s. per week. Students from other counties, £2 10s. per week. Day students, 10s. per week.	The Principal, Hertfordshire Agricultural Institute, Oaklands, St. Albans.
Northamptonshire County Council.	Northamptonshire Farm Institute, Moulton, Northampton.	(*a*) Winter Course of 22 weeks (October to March) in the science underlying the practice of Agriculture. (*b*) Summer Course, for Women, of 10 weeks (May to July) in Dairy Farming. (*c*) A limited number of Farm pupils can be taken from April to October for practical training in mixed farming with special reference to Live Stock Husbandry.	Resident pupils:— (1) From Northamptonshire. (*a*) Winter Course, £1 6s. per week. (*b*) Other courses, £1 10s. per week. (2) From outside the county. (*a*) Winter Course, £1 15s. per week. (*b*) Other courses, £2 per week. Non-resident pupils:— (1) From Northamptonshire, 5s. per week. (2) From outside the county, 10s. per week.	The Principal, Farm Institute, Moulton, Northampton.
Somerset County Council.	Cannington Court Farm Institute, near Bridgwater.	(*a*) Agriculture and Horticulture, one year's course, three terms each of 12 weeks' duration. (*b*) Dairying and Poultry-keeping—Full course, 12 weeks; short courses, 4 weeks.	Somerset students, £18 per term. Other students, £28 per term. (For short courses, £1 15s. and £2 10s. per week respectively.)	The Principal, Farm Institute, Cannington, Bridgwater.
Staffordshire County Council.	Staffordshire Farm Institute, Rodbaston, Penkridge, Stafford.	(*a*) Winter Course in Agriculture or youths from 16-20 years, 22 weeks (October to March). (*b*) Summer Courses for women in Dairying, Poultry-keeping, Bee-keeping and Horticulture, 11 weeks (April-July).	Fees for Winter Course—Tuition fee, all students, £5; maintenance fee, students resident in administrative county of Stafford, £25; students from outside the county, £45; day students, £7 10s. Fees for Summer Course—Inclusive fee for students resident in administrative county of Stafford, £12; students from outside county, £20.	The Principal, County Farm Institute, Penkridge, Stafford.

County Council (or other body) responsible for Institute.	Name and location of Institute.	Description of Courses.	Fees. (Board, lodging and tuition unless otherwise stated.)	Address for further particulars.
ENGLAND (*cont.*) Trustees of the Earl of Iveagh's Foundation.	Chadacre Agricultural Institute, Hartest, Bury St. Edmunds, Suffolk.	(*a*) Course in Agriculture for male students comprising two Winter Sessions of six months (two terms) each. (*b*) Summer Courses (nine weeks each) in Dairying, Horticulture, Poultry-keeping and Bee-keeping, for women students.	Male students—FREE tuition, board and residence to class of student for whom the Institute is intended. Female students—resident in the county of Suffolk; tuition and residence FREE board 15s. per week. Students resident outside the county of Suffolk; board residence and tuition 25s. per week.	The Principal, Chadacre Agricultural Institute, Hartest, Bury St. Edmunds.
WALES. Carnarvonshire County Council.	Madryn Castle Farm School, Pwllheli.	(*a*) Winter Course in Agriculture for men (20 weeks), October to March. (*b*) Summer course in Dairying, Poultry-keeping, Bee-keeping and Domestic Science for women (12 weeks, April to July.	(*a*) Carnarvonshire students, £15. Other students, £20. (*b*) Carnarvonshire students, £9. Other students, £12.	The Principal, Madryn Castle Farm School, Pwllheli.
Denbighshire County Council.	Llysfasi Farm Institute, Ruthin.	(*a*) Autumn Course in Agriculture for men (10 weeks), October to December. (*b*) Winter Course in Agriculture for men (10 weeks) January to March, in continuation of (*a*). (*c*) Spring Course in Dairying, Horticulture and Poultry-keeping for women (12 weeks), April to July. (*d*) Summer Course in Dairying for women (10 weeks), July to September.	Board and lodging, £1 1s. per week. Tuition, £1 16s. per month to Denbighshire students and £3 per month to others.	The Principal, Llysfasi Farm Institute, Ruthin.
Governing Body for administration of William Jones's Foundation.	Monmouthshire Agricultural Institution, Usk.	(*a*) One years' Certificate Course. (*b*) Two years' Diploma Course. Winter Term of 22 weeks (October to March). Summer Term of 22 weeks (April to September). These courses include all branches of Agriculture. Students may specialise in General Agriculture, Dairying, Poultry-keeping and Commercial Horticulture, the last named subject being a particular feature.	Tuition, board and residence:— £15 per session (22 weeks) for Monmouthshire students; £32 10s. for other students. Tuition only:— £2 per session for Monmouthshire students; £5 for other students.	The Principal, Monmouthshire Agricultural Institution, Usk, Newport, Mon.